Salmonid Enhancement Program--Preliminary Notes on New Information in Salmonid Hatchery Propogation

D. F. Alderdice, F. E. A. Wood and
D. W. Narver

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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Canadian Data Report of Fisheries and Aquatic Sciences

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Les numéros 1 à 25 de cette série ont été publiés à titre de relevés statistiques, Services des pêches et de la mer. Les numéros 26 à 160 ont été publiés à titre de rapports statistiques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 161.

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Canadian Data Report of

Fisheries and Aquatic Sciences No. 496

November 1984

SALMONID ENHANCEMENT PROGRAM--PRELIMINARY NOTES ON NEW INFORMATION IN SALMONID HATCHERY PROPOGATION

by

D. F. Alderdice, F. E. A. Wood[1], and D. W. Narver[2]

(Editors)

Department of Fisheries and Oceans

Fisheries Research Branch

Pacific Biological Station

Nanaimo, British Columbia V9R 5K6

[1]Department of Fisheries and Oceans
Regional Planning and Economics Branch
Vancouver, British Columbia
V6E 2P1

[2]British Columbia Ministry of Environment
Fish and Wildlife Branch
Parliament Buildings, Victoria, B.C.
V8V 1X4

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ABSTRACT

Alderdice, D. F., F. E. A. Wood and D. W. Narver (Eds.). 1984. Salmonid enhancement program--preliminary notes on new information in salmonid propogation. Can. Data Rep. Fish. Aquat. Sci. No. 496: 102 p.

Rapid developments in the Federal-Provincial (B.C.) Salmonid Enhancement Program disclosed the need to move new information from data producers to users (e.g. research to operations) more rapidly than traditional methods would allow. To overcome this difficulty, a memorandum (InfoMemo) was developed for preliminary, informal reporting within the Program of new or useful information in salmonid hatchery technology. There has been a continuing demand for copies of these memoranda from both within and outside of the Enhancement Program. This report gathers together the first 100 InfoMemos in the series. They deal in general with biological problems relating to manipulation of broodstock, gametes, incubating eggs, alevins, juveniles and returning adults of Pacific salmon (Oncorhynchus) and steelhead trout (Salmo gairdneri) and associated developments in hatchery technology.

RESUME

Alderdice, D. F., F. E. A. Wood and D. W. Narver. (Eds). 1984. Salmonid ehnhancement program--preliminary notes on new information in salmonid propogation. Can. Data Rep. Fish. Aquat. Sci. No. 496: 102 p.

Les développements rapides au sein du Programme fédéral-provincial (C.-B.) de mise en valeur des salmonidés ont mis en lumière le besoin de communiquer aux utilisateurs, plus rapidement que les anciennes méthodes le permettent, les nouvelles données recueillies par les chercheurs. Devant cette difficulté, on a mis au point une note de service (InfoMemo) pour faire état d'une façon préliminaire et officieuse, au sein du Programme, des données nouvelles ou utiles sur les techniques d'élevage salmonicole. Or, tant de l'intérieur que de l'extérieur, les demandes de copies de ces notes n'ont cessé d'affluer. Le présent rapport regroupe les cent premiers InfoMemos de la série, lesquels portent en général sur des problèmes d'ordre biologique relatifs à la manipulation des géniteurs, des gamètes, des oeufs en incubation, des alevins, des juvéniles et des adultes amontants de saumons du Pacifique (Oncorhynchus) et de la truite arc-en-ciel (Salmo gairdneri) anadrome ainsi qu'à des développements connexes dans les techniques piscicoles.

INTRODUCTION

From its inception in 1977, the Federal-Provincial (B.C.) Salmonid Enhancement Program (SEP) has been working to the objective of returning Canada's Pacific anadromous salmonid resource to historic levels (McDonald 1977). Various contributing technologies include spawning channels, hatcheries, fishways, incubation boxes, Japanese-style hatcheries, lake enrichment, removal of obstructions and stream improvement. Components of the enhancement process, related to fish stocks and facility sites, include stock manageability, site reconnaissance and feasibility, design and construction, operation and maintenance, and evaluation of results.

One set of activities within the Program involves projects designed to find ways of improving and optimizing the contribution of salmonid hatcheries to the enhancement process. In 1979 it became clear that traditional means of communication were not moving new or useful information fast enough between producers and users of information to be of maximum benefit in the rapidly evolving Program. For example, research personnel dislike releasing recommendations based on partly processed data, which could be misinterpreted. On the other hand it often was found difficult to respond effectively to the perceived information needs of management and operations personnel whose priorities are evolving or changing rapidly.

As a partial solution to the problem, an internal memorandum (InfoMemo) was devised to provide a rapid, informal means of communicating new or useful information at a preliminary or pre-publication stage. Initially these were used by research personnel to pass their findings to the operations (i.e. hatchery) sector. Gradually, operations personnel began using the medium to provide data from their own findings in hatchery and related problems. Although these summaries are strictly provisional in nature, there has been a continuing call for them from within the Department of Fisheries and Oceans, the provincial fish culture system, and from others interested in the hatchery production of salmonids.

To satisfy continuing requests, the first 100 InfoMemos of the series are consolidated in this report. They are presented in numerical order. A subject index is provided. It lists information on biological problems associated with manipulation of broodstock, gametes, eggs and alevins, culture and release of juveniles, post-release juveniles, and return of adults. Some general entries relate to enhancement facilities and management of stocks.

ACKNOWLEDGMENTS

Communication of information in the summaries contained herein was made possible largely through interest and effort of the individual authors. Further details on the subject of each InfoMemo may be obtained from the authors at the locations indicated. In general the items originate from three

sources: (1) the Pacific Biological Station and West Vancouver Laboratory of the Fisheries Research Branch, (2) various offices and hatcheries of SEP Enhancement Operations (Vancouver), and (3) offices and hatcheries of the Provincial Fish and Wildlife Branch (Victoria). Special thanks are due D. T. Barrett, South Coast Unit (SEP Enhancement Operations), for promoting interest among personnel in the hatchery service.

REFERENCES

McDonald, J. E. (Ed.). Salmon enhancement program. Annual Report 1977. Fisheries and Environment Canada, Vancouver, B.C. 84 p.

INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 14, 1979

MEMO NO. 1

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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SUBJECT - Juvenile Production, Hatcheries

Item - Size and time of release, coho juveniles

Results of the Rosewall Creek (Vancouver Island) experimental releases of juvenile coho are complete and being analyzed. Juveniles were released at three different sizes (small, medium, large) at four different times (in April, May, June, July). Maximum returns of 40-41% (catch + escapement) occurred for early June release of fish averaging 19.5 g; for that release, maximum biomass of returning adults also was obtained. Based on the Rosewall data, total returns near 49% are predicted for 21 June releases of 24-25-g smolts; of the 49% expected return, 5% are predicted to be jacks.

Compared with conditions of release maximizing adult returns are those maximizing benefit-costs. Based on the Rosewall data, maximum benefit-cost ratios near 15:1 are predicted for release of 13-15-g smolts about 14-15 June. In summary, the data show maximum predicted adult returns are associated with later (21 June) release of larger (23-24 g) fish, with benefit-cost ratios somewhat less than maximum. On the other hand, maximum predicted benefit-cost ratios are associated with earlier (14-15 June) release of smaller (13-15 g) fish, with adult returns somewhat less than maximum. These limits and interpolated alternatives are being calculated for economic scrutiny.

Possible site-specific variations in these relations need further examination, which begins this fall. In addition, annual variations may occur at each site. In both cases, time and size at juvenile release may relate to distribution and abundance of appropriate food organisms in neighbouring waters. Hence a marine monitoring program may be basic to an understanding of how time and size at release is related to maximum adult returns for all hatchery-produced salmonids.

For further details contact: T. Bilton (Nanaimo)
D. Alderdice (Nanaimo)
(surface analysis)

EMPHASIS:
(1) Identification of priority problems or potentials, or
(2) Announcement of new data or insights into solutions to current problems prior to final analysis or formal reporting.
Information items are preliminary and not final. Recipients are invited to participate. Send your items (please be brief, 5 to 15 lines) to one of the above contacts.

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CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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SUBJECT - Water Quality Criteria

Item - Minimum oxygen requirements, salmon culture.

Laboratory tests with coho and sockeye fingerlings show that maximum growth rates can be achieved at oxygen levels above 4.3 mg/L at 15°C. That is, 4.3 mg/L is a threshold for maximum growth. Zero growth occurred at 2.5 mg/L dissolved oxygen. These tests, conducted under high flushing rates, provide a baseline for determining the effects of nitrogenous excretion and pH on growth in relation to dissolved oxygen levels. The latter tests are to commence in 1979.

Item - Minimum environmental oxygen levels, Great Lakes.

In a report of the Review Committee for the Dissolved Oxygen Objective for the Great Lakes (International Joint Commission, January, 1979) dissolved oxygen criteria for all life stages of Great Lakes fishes were recommended as follows: "the dissolved oxygen level should not be less than an average of 6.5 mg/L nor less than 5.5 mg/L at any time over 24 hours and across a temperature scale of 0°C-25°C."

- for further details contact: J. R. Brett (Nanaimo)

ERRATUM

Memo No. 1, 14 May, 1979

Line 12: should read 24-25-g instead of 24-45-g.

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MEMO NO. 3

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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SUBJECT - Disease prevention in hatcheries

Item - Erythromycin rinse of newly fertilized coho eggs against transmission of bacterial kidney disease (KD).

In 1977, a first trial of erythromycin against KD transmission resulted in considerable mortality among treated coho eggs. A subsequent search for the cause of mortality has been successful. Six potential sources of the problem were examined:

- possible toxicity of the erythromycin rinse solution
- delay between taking the adults and fertilization of the eggs
- egg/sperm contact time (1 or 10 min)
- number of rinses employed (1 or 2)
- delay between activation and placing eggs in trays
- height from which eggs were poured into trays from fertilization container.

Of these factors only the latter two were important at all, and they were highly significant. In effect, the problem is one of high susceptibility of eggs to mechanical shock after fertilization. To avoid mechanical shock: fertilize eggs, activate and rinse with water, decant eggs immediately into Heath tray of erythromycin solution, set tray in stack (not pushed in) for contact period, then carefully push tray in to start water exchange and continue with incubation. If fertilized eggs are to be handled (transported, dispensed) in the first hour after activation, this should be done within 5 min of activation if increased egg mortality is to be avoided. With this, a technique now exists to allow further examination of the efficacy of erythromycin rinse as a means of inhibiting KD transmission. To date, however, survivors of the first 1977 trial appear free of KD.

- for further details contact: J. Jensen (Nanaimo)
G. Hoskins (Nanaimo)
B. McLean (Quinsam)

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CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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SUBJECT - Water Quality Criteria, Incubation Systems

Item - Minimum incubation bulk water velocities

Minimum acceptable (emergency) flow of water past single layer of salmon eggs near hatching at 10°C is equivalent to a bulk velocity (apparent velocity through cross-sectional area of incubator) of 75 cm/hr. Relation of this minimum to multiple egg layers (increasing densities) are not yet known. Interim suggestion: consider 2 × minimum -- 150 cm/hr -- as minimum working bulk velocity.

- for further details contact: D. Alderdice (Nanaimo)

Item - Minimum incubation oxygen levels

In relation to bulk velocity (above), minimum oxygen levels at egg incubator outfall should not be lower than about 6.5 mg/L at any temperature (Protection level C) (Sigma Resource Consultants, 1979). Recommend that egg density or bulk velocity be adjusted to stay above that level. However, in terms of ensuing quality of fry, the higher the oxygen level is toward saturation, the better the quality should be.

- for further details see: 1979. Summary of Water Quality Criteria for Salmonid Hatcheries. Sigma Resource Consultants, Ltd.

Item - Un-ionized ammonia and sockeye eggs

Coagulated yolk syndrome found highly correlated with incubation of eggs (fertilization to hatching) at low oxygen (3 mg/L) and high un-ionized ammonia (100 μg/L) levels. Syndrome absent at low oxygen or high un-ionized ammonia levels, but present when both occur together. Threshold levels not known, but other data indicate un-ionized ammonia influences alevin quality down to 2 μg/L.

- for further details contact: J. Jensen (Nanaimo)

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CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Laboratory - 2

SUBJECT - Salmon stock identification

Item - Parasite "tags" for sockeye salmon

A microscopic parasite (the myxosporidan Myxobolus neurobius) has been found to occur in the brain of almost all sockeye from Sproat Lake (Somass R.) and Henderson Lake, but is absent from almost all sockeye from Great Central Lake (Somass R.). These three stocks are fished commercially in Barkley Sound and the absence of the parasite from G. C. L. sockeye (one of the lakes being fertilized in the Lake Enrichment Program) provides an effective means of identifying these sockeye in the commercial catch.

A similar distinction exists between Owikeno Lake and Long Lake sockeye. Results of sample examination from the 1978 adult escapement indicate that the parasite occurs in almost all Owikeno sockeye but is absent in sockeye from Long Lake (fertilized in the Lake Enrichment Program), thus providing a powerful tool for segregating sockeye from these two lakes in the Smith-Rivers inlets fisheries.

An efficient and practical technique for detecting the parasite has been developed. It can be used with either fresh or frozen samples. An important characteristic of the parasite is that it is acquired during the early freshwater phase of sockeye and is retained throughout the life of the fish.

This parasite-tag method has great potential for application in stock management and assessment of the effectiveness of lake enrichment in the areas noted above. Commercial fishery samples will be examined from the 1979 Barkley Sound catches to test this potential.

For further details contact: L. Margolis or
T. E. McDonald
(Nanaimo)

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CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Laboratory - 2

SUBJECT - Juvenile production, hatcheries

Item - Returns from spring and fall releases of accelerated and normal-age coho smolts

Data have been analyzed for a) spring release (10 June 74) of accelerated (zero-age) and normal age coho smolts and b) fall release (6 Nov. 74) of accelerated coho smolts. Juveniles were released at three different sizes (small, medium, large) and returns were based on catch + escapement. Results are summarized as follows.

Release	Spring Accelerated	Spring Normal	Fall Accelerated
Aver. release wt. (g)	9	19	10
Age at release (mo.)	6	18	11
Return (%)	3.3	47.5	6.5
Catch/Catch + escapement (%)	84	79	94
Benefit-costs			
small:	(6 g)0.1:1	(11 g)11:1	(7 g)2.1:1
large:	(14 g) 1:1	(23 g) 7:1	(13 g)1.5:1

Returns and benefit-costs may be compared for fish of similar size -- small, normal (11 g) and large, accelerated (14 g) smolts released in spring. Results suggest unrecognized factors reduce survival of accelerated smolts. In addition, returns from accelerated smolts released in fall are about double those for spring release (6.5 vs 3.3%), yet both are much lower than return for normal smolts released in spring (47.5%). Based on benefit-costs, all of the data suggest neither spring nor fall release of accelerated (zero-age) coho smolts is economically feasible.

For further details contact: T. Bilton (Nanaimo)

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For internal, informal, rapid exchange of information between data producers & users.

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MEMO NO. 7

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

SUBJECT - Production of Juvenile Salmon

Item - Quinsam River coho fry transplant

A project associated with Quinsam hatchery is the evaluation of the transplant of hatchery-reared coho fingerlings to sections of the Quinsam watershed that are obstructed to adult migration. These areas do not support natural populations of anadromous salmonids. In contrast to the planting of early (unfed) coho fry, the extended period of hatchery rearing prior to stocking was designed to carry the juveniles through the low flow and high temperature period of the Quinsam River. Accordingly, 200,000 reared fingerlings (av. wt. 7.9 g) were released on 3 Oct. 1978 at four locations above obstructions to adult migration on the Quinsam River. Of these, 51.2% were adipose-clipped and coded-wire tagged. Downstream migration was monitored at the Quinsam hatchery using Wolf traps (30 April-6 June 1979).

Of those transplanted, an estimated 16.3% emigrated (av. wt. 12.2 g). Contribution to the fisheries and escapement is expected in 1979 and 1980. The strategy employed uses existing hatchery facilities to rear fry through the early phase of potentially high natural mortality, then transplanting to unutilized or "barren" rearing areas, thereby producing smolts under more natural conditions. The results suggest that the method might be used for producing "natural" smolts inexpensively, in a high distributive manner, as a supplement to hatchery production.

For further details contact: D. Lawseth (Quinsam)
W. McLean (Quinsam)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE July 5, 1979

MEMO NO. 8

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

SUBJECT - Management of Salmon Stocks

Item - Decrease in size of pink salmon

In 1973 Tom Bilton showed from Departmental statistics that pink salmon had decreased in size from 1954 to 1972, and this is now extended to 1951-75. Searching for an environmental explanation, we compared deviations from the trend line with those from the trend of ocean temperatures at the northern coastal stations; the correlations were mostly positive, but weak and non-significant. Even if real, the computed effects would account for only 28% of the mean downward trend in odd years, and for only 9% in even years. Moreover, it is very difficult to picture how environmental effects could make even-year pinks decrease twice as fast as odd-year pinks, or seine-caught pinks decrease faster than those caught by gillnets. Yet that is what has occurred.

The average size of pinks caught by the selective gears has been about 0.3 lb. larger than seined fish in odd years, and 0.5 lb. larger in even years. Assuming that seines catch pinks without selection by size, the average size of spawners is computed to be about 0.38 lb. less than the unfished stock in odd years, and 0.46 lb. less in even years. The hereditary decrease in size would be about 0.3 of the differences above, or 0.11-0.14 lb. per generation. This is enough to make today's pinks average 0.5 to 1.5 lb. less than they were about 1950, in different areas and lines.

Comments and criticisms are solicited: see Fisheries and Marine Service Technical Report No. 820 (1978).

For further details contact: B. Ricker (Nanaimo)
T. Bilton (Nanaimo)
V. Aro (Nanaimo)

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MEMO NO. 9

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

SUBJECT - Management of Salmon Stocks

Item - Decrease in age and size of chinook salmon

The average size of chinook salmon caught in the eastern Pacific Ocean has been decreasing since at least 1920, and continues to decrease. Present average weights are half or less than half of those obtained 50 years ago. Since 1951 the mean size of chinooks caught commercially by trolling has decreased by about 4 lb. in northern B.C. and by about 2 lb. in southern B.C.

Part of this decrease in size is due to capturing more fish early in the season, leaving fewer to be caught later at a larger size. Also, in some areas capture of non-maturing chinooks reduces the number to be caught at older ages. The average age of the spawning fish has been reduced by a year or more, with resulting progressive deterioration of the genetic basis for maturation at older ages. Under present fishing conditions, I see no end to this until practically all "wild" chinooks are jack males and age 3 females. At hatcheries, counter-selection favoring older ages is a possible partial remedial measure.

There is no evidence that trends in the ocean environment have contributed to the downward trend in size of chinook salmon. Size has decreased during a regime of ocean warming, up to 1940, and during a cooling regime since that time.

Al Wood (Vancouver) has a copy of the draft report. Comments and criticisms are welcomed.

For further details contact: B. Ricker (Nanaimo)

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MEMO NO. 10

CONTACTS

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

SUBJECT - Water Quality Criteria, Egg Incubation

Item - Water hardness

Tests were started at Robertson Creek hatchery in 1979 to determine the influence of soft water (18 mg/L as $CaCO_3$) on yolk sac deformities and white spot disease in steelhead alevins. Addition of $CaCl_2$ to incubation water is known to reduce incidence of white spot disease in brook trout. At Robertson Creek, alevins were exposed to three levels of water hardness: 18 (control), 49 and 90 mg/L as $CaCO_3$.

Incidence of yolk sac abnormalities proved low this year, and little direct data were obtained. However, during the tests significant mortality began to occur in the controls (untreated water supply) about 2 weeks after hatching. Among lots of alevins of different ages, mortality was highest in the younger alevins. Gross pathological signs were fungus lesions on the pectoral and dorsal fins. Significantly, mortality associated with the lesions was much reduced at higher levels of hardness:

Hardness (mg/L $CaCO_3$)	Alevin Mortality (%) Rep. 1	Rep. 2	Average
18	33.8	25.3	29.6
49	10.5	9.2	9.8
90	7.7	3.6	5.6

The data are limited and subject to reassessment after further investigation. However, at this time the results suggest $CaCl_2$ might be a useful prophylactic treatment for some problems during alevin development in soft water hatcheries.

For further details contact: B. McLean (Quinsam)
J. Jensen (Nanaimo)
K. Petersen (Robertson Cr.)
G. Cooke (Robertson Cr.)

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INFO memo

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DATE October 1, 1979

MEMO NO. 11

CONTACTS

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Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

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D. Deans - 11
A. Lill - 17
D. Narver - 17
R. Palmer - 13
P. Ryan - 1
K. Sandercock - 24
H. D. Smith - 2
A. Wood - 24
Pacific Biol. Stn. - 22
West Van. Laboratory - 2

SUBJECT - Juvenile production, hatcheries

Item - Early growth rates, cultured chum salmon

Chum fry were raised on OMP mash from a starting weight of 0.35 g for 6 weeks at 5, 10, 15°C in fresh water and at 15°C in 28‰ S sea water. The resulting specific growth rates (G, wet weight basis) respectively were 1.8, 4.4, 5.9 and 5.9% ($\log_e$ g) per day. The growth rates were lower than those measured previously for sockeye fry at similar temperatures, but were close to a G of 6.2%/day derived from LeBrasseur's earlier (1969) study of chum fry. The latter were fed Calanus plumchrus in Saanich Inlet sea water at a temperature of 14-16°C.

For further details contact: J. Shelbourn (Nanaimo)

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MEMO NO. 12

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Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
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West Van. Laboratory - 2

SUBJECT - Juvenile salmonids

Item - Field trapping manual

The Salmonid Trapping Manual will be made available to all regional libraries in November, 1979. It compiles successful field techniques used by the Fisheries and Marine Service to capture juvenile salmonids in rivers, lakes and estuaries of the Pacific Region. The manual reviews past trapping methods, installation techniques and operating conditions. New innovations to equipment and trapping strategies used by the Service are included. Objective of the compilation has been to produce a state-of-the-art manual.

For further details contact: B. D. Tutty
(Vancouver)
K. Conlin
(Vancouver)

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INFO memo

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DATE October 2, 1979

MEMO NO. 13

CONTACTS

D. Alderdice, Pacific Biological Station
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A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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Pacific Biol. Stn. - 22
West Van. Laboratory - 2

SUBJECT - Culture of chinook salmon alevins

Item - Heming, T. A. 1979. Optimal timing of initial feeding, as affected by temperature, in chinook salmon (Oncorhynchus tschawytscha). M.Sc. Thesis, Univ. Victoria, xii + 124 p.

Quinsam Hatchery chinook alevins were introduced to external food at intervals after hatching until yolk absorption was complete in the (unfed) controls (6, 8, 10, 12°C). Optimal time to commence feeding is prior to attainment of maximum alevin wet weight (MAWW), and is not correlated with "swim-up" or "button-up." Emergence (50%) from artificial redds occurred at or very near MAWW (6-12°C). Delaying feeding, until or after MAWW was reached, reduced growth and increased mortality -- particularly in Heath trays (compared with artificial redds). Optimum times to initiate feeding (Heming, Table 17; reproduced below) are shown in relation to thermal units from fertilization, yolk reserve (% of dry yolk weight at fertilization), survival (%) and expected biomass (kg) per 1000 fertilized eggs at 1634 thermal units post-fertilization.

Temp. (°C)	Thermal units (°C-days)	Yolk reserve (%)	Survival (%)	Biomass (kg)
6	1070	22	91.9	3.00
8	1050	25	90.5	2.96
10	1005	30	88.7	2.90
12	950	32	78.5	2.56

For further details contact: T. Heming (Dept. Zoology, UBC, 228-4652)
D. Alderdice (Nanaimo)

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MEMO NO. 14

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Vancouver, B.C. 666-3855

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Pacific Biol. Stn. - 22
West Van. Laboratory - 2
Private growers
(through Hoskins)

SUBJECT - Fish health and furunculosis

Item - Development of drug resistance in Aeromonas salmonicida, causative agent of the disease

Terramycin-resistant strains of causative organism recently encountered in private fish hatchery. When resistance to an antibiotic is developed by a bacterium, further antibiotic treatment is of no advantage. Also, there is danger drug resistance may be transmissible to other, usually susceptible bacteria. Terramycin is one of few chemotherapeutic agents available and effective against furunculosis. To avoid encouraging drug resistance, administer as follows.

(1) Avoid unnecessary, indiscriminant use of drug. Use only with definite diagnosis of infectious agent known to be susceptible.

(2) Monitor losses closely; Terramycin ineffective if applied after disease well established in a stock.

(3) Administer sufficient antibiotic to eliminate infection as soon as possible (not less than 3, not more than 5 grams Terramycin/100 lb. fish per day).

(4) Avoid using drug over prolonged periods.

(5) Avoid continual release of drug to control furunculosis. Instead use good management practices; avoid conditions promoting outbreaks (e.g. over-crowding, excessive handling and/or poor diets).

(6) Mix antibiotic with food so as to minimize leaching before pellets are taken by fish. Feed treated pellets each morning when fish most hungry. Terramycin adheres better to pellets first coated with corn oil (do not use mineral oil).

(7) Check calculations; ensure proper levels of drug being administered.

For further details contact: G. Hoskins (Nanaimo)
G. R. Bell (Nanaimo)

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DATE October 9, 1979

MEMO NO. 15

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Laboratory - 2

SUBJECT - Juvenile Production, Hatcheries

Item - Saltwater rearing of chum fry

The pilot year's operation of Pallant Creek (Queen Charlotte Islands) chum hatchery demonstrated considerable potential for use of Japanese-style seapens in estuarine rearing of this hatchery stock. Preliminary seapen data were:

	Pen #1	Pen #2	Pen #3
Stocking date(s)	Apr 24-25	Apr 28-May 2	May 5-14
Release date	May 24	May 25	May 25
Stocking density	330,000	373,000	201,000
$\bar{W}$t, swim-up (g)[1]	0.4	0.4	0.4
$\bar{W}$t, release (g)[1]	1.9	1.2	0.8
% BW/day (range)	5.2 (3.7-6.4)	4.6 (3.7-6.6)	2.5 (2.4-2.7)

When freshwater-reared (FW) and saltwater-reared (SW) groups of similar timings are compared, growth and condition of SW fish were markedly higher. Due mainly to a more favourable temperature regime (9.5-12.5°C), the Pallant operation met or exceeded most of stated Japanese goals for rearing:

	Pallant 1978-79	Japanese goal
Egg-fry survival (%)	85	90
Fry-smolt survival (%)	99	80
Egg-smolt survival (%)	84	72
Growth (% BW/day)	4.2	4
Release size (g)	0.8-1.9	0.8-1.0 (min)

The ultimate measure of seapen rearing success requires evaluation of smolt-adult survivals in 1981-83 when SW, FW, and wild marked groups return. Nevertheless the juvenile production data are most encouraging, and suggest wider use of this technique in B.C.

For further details contact: B. Shepherd (Vancouver)

[1] Sampling probably biased to smaller fish.

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DATE December 3, 1979

MEMO NO. 16

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

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Pacific Biol. Stn. - 23
West Van. Lab. - 2

SUBJECT - Fish-marking by fin-clipping

Item - Differential regeneration rates

It is a common assumption that the adipose fin regenerates less often or less extensively than rayed fins. There is evidence from some long-term mark and recovery experiments that this contention may not be true.

I re-examined published data from our Headquarters Creek pink salmon marking programs. Double fin clips were used -- the adipose (Ad) and either ventral (EV). Fish marked as unfed fry were recovered as adults at the hatchery weir. Regeneration of fins as a percentage of marks recovered is shown in the table.

	Brood year				
	1968	1970	1971	1972	$\bar{x}$
Ad fin	6.54	2.67	4.20	1.54	3.53
EV fin	3.38	1.89	0.00	0.24	1.11
Σ(both fins)	9.50	4.46	4.20	1.77	(Ad/EV
No. fish	537	381	119	1698	= 3.2)

As the table shows, in all years regenerated adipose fins were encountered more often than regenerated ventrals (3.2 times on average, by $\sqrt{x + .5}$ transform). Note too that as we gained experience, the total rate of regenerated marks dropped from 9.50 to 1.77% in the four tests.

The adipose fin of older fish is better differentiated. Hence it would be useful to compare results with similar data on fish clipped at an older age -- e.g. coho smolts. If anyone has suitable data, please let me know.

For further details contact: Rob Bams (Nanaimo)

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DATE January 22, 1980

MEMO NO. 17

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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Pac. Biol. Stn. - 23
West Van. Lab. - 2

SUBJECT - Controlled sex differentiation of coho salmon

Item - Sex ratios of estrogen-treated groups reared to maturity in captivity.

Fertilized eggs were obtained from coho spawned in May, 1977, under photoperiod control by D. MacQuarrie. They were divided into three groups. Two groups were treated at the eyed egg and alevin stages and for the first 3 months of feeding with the natural estrogen which occurs in mature salmon. The third group served as a control. The resultant smolts were transferred to sea water May, 1978, and back to fresh water November, 1979. Sex ratios and state of maturity in the groups December, 1979, were as follows.

Treatment	No. fish	% female mature/immature	% male mature	% sterile
High estrogen	34	94/6	-	-
Low estrogen	52	92/4	-	4
Control	41	51/3	46	-

The eggs from 20 fish from each of the estrogen-treated groups and the control group have been fertilized with milt from Capilano hatchery males. The sex ratios resulting from these individual crosses will indicate whether the male or female is the heterogametic sex in coho and will indicate the proportion of 'genetically male' adults in the estrogen treatment groups. The first eggs to be fertilized from each group showed a fertilization rate in excess of 90%.

These results indicate the possibility of generating largely female stocks of coho salmon. This opens up new management options for the culture of these and other salmonids.

For further details contact: E. M. Donaldson
G. A. Hunter
Resource Services Branch,
West Vancouver Laboratory

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DATE January 22, 1980

MEMO NO. 18

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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A. Wood - 23
Pac. Biol. Stn. - 23
West Van. Lab. - 2

SUBJECT - Controlled sex differentiation of coho salmon

Item - Sex ratios of androgen-treated groups reared in captivity for 2 1/2 years.

Fertilized eggs were obtained from coho spawned in May, 1977, under photoperiod control by D. MacQuarrie. Two groups of these eggs were treated with androgen at the eyed egg and alevin stages and for the first 3 months of feeding. A control group was shared with a study on the effect of estrogen (InfoMemo No. 17). The resultant smolts were transferred to sea water May, 1978, and back to fresh water November, 1979. Sex ratios and state of maturity in the groups December, 1979, were as follows.

Treatment	No. fish	% mature female	% mature male	% immature
High androgen	48	2	4	94
Low androgen	10	-	30	70
Control	41	51	46	3

Coho in the androgen-treated groups which did not mature in the fall of 1979 have been returned to sea water for a further year of rearing. It is evident that the treatment has either delayed the onset of sexual maturation in these fish or has, in fact, sterilized them. Sterile fish may lack the propensity to undergo an anadromous migration. Thus if excess returns of adults were to occur at a hatchery, this technique when refined could be used to produce smolts that would remain in the fishery rather than return to the hatchery as jacks or sexually mature adults.

For further details contact: E. M. Donaldson
G. A. Hunter
Resource Services Branch,
West Vancouver Laboratory.

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DATE January 22, 1980

MEMO NO. 19

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Lab. - 2

SUBJECT - Gill disease and water treatment

Item - A sand biofilter for removal of ammonia nitrogen.

A simple economical sand biofilter constructed of readily available materials successfully reduced ammonia nitrogen levels in a water supply to a cutthroat rearing pond in Surrey.

Re-occurring gill problems in anadromous cutthroat fingerlings were traced to high ammonia nitrogen levels in the artesian water supply. Fish exhibited clubbed gill filaments followed by heavy concentrations of myxobacteria. The 110-gal/min water supply contained 0.46 ppm ammonia-N and this combined with a pH of 8.1 and an 11 C temperature resulted in a un-ionized ammonia level of 0.012 ppm.

A biofilter for bacteria to convert ammonia to nitrite and nitrate was constructed using a 10-ft. diameter fiberglass pond and pvc piping. A 2.5-foot layer of chicken grit (crushed granite) on top of 1.3 feet of drain rock and pea gravel served as the filter media. Water, which enters the downflow filter through a spray bar, is passed through the media and picked up by collector pipes below the gravel and flows by gravity to the rearing pond.

To prevent nitrite poisoning on start-up only, one-quarter of the flow was directed to the filter. Nitrification commenced in 5 weeks and was fully operational with the total flow in 6 weeks. With a weekly backwash cycle, ammonia-N levels are below detectable concentrations and nitrite is present in trace amounts. During the first 3 weeks of full operation the biofilter has been trouble free.

For further details contact: D. Peterson
B. Wardman
Fraser Valley Trout Hatchery,
Abbotsford, B.C.
(853-8394)

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INFO memo

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DATE February 20, 1980

MEMO NO. 20

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Lab. - 2

SUBJECT - Salmon Stock Identification

Item - Chum fry tagging with half-length coded wire tags.

Chum fry reared for six weeks at the Community Development hatcheries at Cowichan and Sliammon were tagged with half-length CWT to evaluate field application of large numbers of tags using inexperienced crews hired locally.

Equipment modifications are needed to detect smaller tags. Nose cones are the most critical component and require further improvement. Tag loss and mortality can be reduced by limiting tagging to fish over one gram and grading for a uniform size range. Cost of tagging, using half-length CWT, is roughly twice that using full-length tags.

	Cowichan	Sliammon
Crew size	7	6
Tagging days (2 machines/2 shifts)	9	7
Total tagged	55,702	39,991
Retagged	20.0%	13.3%
24-hour tag loss	14.8%	10.9%
Overall mortality	11.1%[1]	19.4%[2]
Mean, (size range) (mg)	91 (79-109)	85 (64-115)
Total tagged released	48,193	29,041

[1]Includes fungus infection mortalities.
[2]Includes nitrogen super-saturation mortalities.

For further details contact: R. W. Armstrong
D. G. Clark
A. Stefanson
(Vancouver)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 20, 1980

MEMO NO. 21

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

T. Bird - 5
D. Deans - 13
A. Lill - 16
D. Narver - 17
R. Palmer - 12
P. Ryan - 1
K. Sandercock - 22
H. D. Smith - 2
A. Wood - 23
Pac. Biol. Stn. - 23
West Van. Lab. - 2

SUBJECT - Juvenile Production, Hatcheries

Item - Seawater challenge tests of hatchery fall chinook.

Seawater challenge tests have been conducted on experimental and production hatchery chinook juveniles to determine the progress of smoltification. The results of tests conducted in 1977 indicated that most groups of hatchery chinook were not fully smolted at the time of release and that small groups of chinook held at the Quinsam hatchery to a size of 18 g in mid-July showed excellent hypoosmoregulatory capacity typical of smolts (FMS Tech. Rep. 761). Subsequent tests in 1978 and 1979 have confirmed this pattern at Quinsam. Yearling chinook at the Puntledge hatchery demonstrated a comparable performance in the seawater challenge test at a weight of 120 g in early May. Accelerated underyearling chinook at Big Qualicum River adapted well to sea water at a size of 7 g at the end of May.

W. S. Zaugg of the U.S. National Marine Fisheries Service has obtained evidence that fall chinook released into the Columbia River at a time when the activity of the gill transport enzyme, Na^+,K^+-ATPase is high, spend less time in the estuary than those released when enzyme activity is low.

It is anticipated that this information will be of value in designing size and time of release trials for juvenile chinooks.

For further details contact: C. Clarke
(Nanaimo)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE March 20, 1980

MEMO NO. 22

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Vancouver, B.C. 666-3855

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SUBJECT - Juvenile Production, Hatcheries

Item - Precision of numerical estimates in juvenile and adult sampling.

Statistical methods are available for calculating the confidence limits of survival estimates, and for estimating the required size of marked release groups and sampling rates. The methods are suitable for single release groups and for comparisons between multiple release groups such as diet or time and size of release studies.

Mark recovery programs can be designed to give statistical confidence limits, at lowest cost, by optimizing marking or sampling rates. In addition, conflicting sampling requirements can be avoided where multiple programs are concurrent.

Marking and sampling rates depend on the species and objectives of the study. Formulae and programs for Hewlitt-Packard and Texas Instrument calculators are available on request.

For further details contact: B. McLean
(Quinsam Hatchery)
D. Harding
(Vancouver)
C. West
(Vancouver)

Editor's Note: Much of what is alluded to here is new or unpublished, and is of considerable interest not only to Operations but also to Research and Management viewpoints. Hopefully, this work can be expanded -- for example, into a Technical Report -- to increase availability, understanding and application of the techniques involved.

D.A.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 16, 1980

MEMO NO. 23

CONTACTS

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A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Lab. - 2

SUBJECT - Summer Steelhead Fry Releases

Item - Enhancement of summer run steelhead in Silverhope Creek

Eleven thousand four hundred (11,400) marked summer steelhead fry were released July 19, 1979, to Silverhope Creek above Silver Lake near Hope. Half (5,700) were released at a single point release site (super-saturation), half were uniformly distributed at 9 g/lin. m over a 1,850 m section (sub-saturation).

A month later the mean absolute density (fish/m^2) of steelhead/rainbow fry increased 5-8 times within or about release sites relative to 1978 (pre-release) data. The mean biomass density (g/m^2) of steelhead/rainbow fry increased 7-12.5 times. Super-saturation resulted in a site-specific fry biomass density of 5.87 g/m^2. Densities of older steelhead/rainbow age groups and the Dolly Varden char population were not significantly affected by the releases. Overall survival (mid-July to late August) from the releases was 70%. Survival from the sub-saturation release (77%) appeared higher than that from the super-saturation release (63%).

Upstreaming of larger hatchery fry and downstreaming of smaller wild fry was evidenced about the point (super-saturation) release site. Similar, less definite migrations were also suggested for the scatter (sub-saturation) release.

Sampling in 1980 will determine the survival rates to parr size of the released groups.

For further details contact: Bob Griffith
Fish & Wildlife Branch
Victoria (387-3660)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE August 9, 1980

MEMO NO. 24

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
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SUBJECT - Carrying Capacity of Coho Streams

Item - Analysis of available data on annual smolt yields as a function of accessible rearing space.

Data were obtained from the literature and unpublished sources for 21 streams, 2 ponds and 2 side channels. Variables examined were coho smolt yields expressed as numbers and biomass, and rearing space expressed as accessible stream length and area. Results of the analysis are as follows.

- The curvilinear equation $y=ax^b$ best describes the relationships between smolt yield and rearing space for the 4 variables tested.
- Biomass is more representative of carrying capacity than numbers. Area and length are equally representative of carrying capacity except for small streams where area is more representative.
- Large streams are more productive per unit length but less productive per unit area.
- Mean weight of smolts tends to increase with increasing size of stream.
- Mean annual smolt yields for small streams are calculated to be 1,022/km (6.4 kg/km) or 73/100 m^2 (0.46 kg/100 m^2). Comparative yields for large streams are 1,894/km (26.0 kg/km) or 24/100 m^2 (0.35 kg/100 m^2).

For further details contact: Dave Marshall
Fisheries and Oceans
Vancouver
(666-3907)

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DATE August 22, 1980

MEMO NO. 25

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D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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SUBJECT - Juvenile Production, Hatcheries

Item - Stress effects of crowding.

Juvenile coho were grown at four densities in Burrow's ponds at Capilano hatchery, between August, 1978, and June, 1979. In samples taken in June, weight, length and condition factor (W/L^3) were inversely proportional to the number of fish/pond. The trend towards leaner fish expressed by the lower condition factor was reflected in decreasing fat content and increasing moisture content at higher fish densities.

When representative samples were taken of small and large fish (33.3 percentiles) from the least and the most crowded ponds and analyzed histologically all small fish sampled from the most crowded pond showed increased interrenal activity (ICND), normally associated with stress. No other smolts showed similar changes.

Stress reduces the capacity of the fish to perform physical activity and its ability to withstand disease. Sandercock, F.K., and Stone, E.T. (NW Fish Cult. Conf., Dec., 1979, pp. 136-142) have shown that rearing under crowded hatchery conditions decreases the return rate of coho salmon. The results presented here indicate that several symptoms of stress response are present in the crowded fish. The smaller fish in a population are identified as the ones most severely affected and therefore least likely to survive life in the ocean and return as adults.

Fish/pond	56600	75800	84400	104600
Weight (g)	17.7	16.6	15.4*	13.8*
Length (cm)	11.8	11.6	11.6	11.1*
Condition factor	1.06	1.05*	0.98*	0.98*
Body moisture (%)	77.3	77.0	77.8	78.4*
Body fat (%)	4.3	4.4	3.9	3.6*
ICND (μm) large fish	6.12			6.29
small fish	6.01			6.82*

*Significantly different from the least crowded pond (Duncan's multiple range test, $\alpha < 0.05$).

For further details contact: U.H.M. Fagerlund, J.R. McBride (West Van.); E.T. Stone (Capilano Hatch.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE September 22, 1980

MEMO NO. 26

CONTACTS

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

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West Van. Lab. - 2

SUBJECT - Stream Improvement Projects

Item - Assessment of chum salmon production from improved side channel spawning areas.

A study was conducted during the period November, 1979, to June, 1980, to assess chum salmon production in seven groundwater-fed side channels that had undergone bioengineering improvement work to upgrade spawning conditions. Three of the study sites were located in the Squamish River system, two at Norrish (Suicide) Creek and one at each of the Harrison and Vedder rivers.

The estimated escapement of chum salmon to individual sites ranged from 479 to 6,582 fish, and subsequent fry output from 6,000 to 1,543,000. Corresponding survival rates from potential egg deposition to migration ranged from 1% to 33.5%. The average survival rate for the seven sites (16.3%) approximated twice the average (7.9%) of six natural spawning areas in British Columbia studied by other fisheries workers (Neave, Hunter and others).

The highest fry production per unit spawning area ($517/m^2$), but one of the lowest survival rates (7.1%), occurred at the site with the highest spawning density (2.5 females/m^2). At the next most densely spawned site (0.5 females/m^2), fry output was comparable ($450/m^2$), yet survival rate was the highest (33.5%). The relationship between fry production and spawning density indicates that a density greater than 0.5 females/m^2 does not appreciably increase fry production.

Coho salmon utilized all seven study sites for spawning and rearing. Small numbers of trout fingerlings were present at all sites but one.

For further details contact: D. Marshall
(Vancouver)
(666-3907)

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DATE September 24, 1980

MEMO NO. 27

CONTACTS

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A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

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West Van Lab. - 2

SUBJECT - Fish Culture

Item - Relations between water quality, fish density, disease and stress.

On a recent trip to West Germany I had the opportunity to visit two warmwater intensive recycled fish culture systems -- one in Ahrensburg (25°C; eels, siganids), the other in Stulln (15°C; rainbow trout). The systems use ozonation for control of pathogens and breakdown of organic wastes, in association with a foam tower for removal of settleable and non-settleable solids, a biological filter for the oxidation of ammonia and nitrites to nitrates, and injection of oxygen to maintain dissolved oxygen levels; pH also is controlled. In operation, these systems have shown that there is a striking relationship between water quality, fish density, disease, and symptoms of stress. In the eel system stress is minimized at high densities; at lower densities stress is higher and is related to aggressive behaviour of larger individuals toward smaller fish. Both eels and siganids have been disease free in culture, the latter being in their 19th cultured generation. In brief, excellent water quality appears to allow disease-free culture at high fish densities without measurable stress. Development of the closed-system technology began about 10-12 years ago. The work is contributing to the development in the private sector of marketed systems for intensive fish culture in association with sources of waste heat. I'm sure visits or collaborative studies could be arranged.

For further details contact: D. Alderdice (Nanaimo)

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DATE May 8, 1981

MEMO NO. 28

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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Pac. Biol. Stn. - 23
West Van. Lab. 5

SUBJECT - Premium Diets for Chinook Salmon

Item - The effects of a high quality protein on growth and feed utilization, and dry vs. moist diets.

A feeding trial was conducted at the West Van. Lab. to investigate the influence of dietary protein and energy level on performance of juvenile chinook salmon. The diets comprised very high quality protein (freeze-dried pollock and euphausids), highly digestible lipid (herring oil) and carbohydrate (dextrin and glucose) sources. Further, we compared moist OMP (29% H_2O) to freeze-fried OMP (2% H_2O) to determine whether dietary moisture content would influence performance. Fish were fed 3 times daily for 105 days (March 4-June 17, 1980).

	Dry pollock-euphausid diets			Freeze-dried OMP	Reg. OMP
% protein	15	25	35	49	49
% moisture	10	10	10	2	29
Weight gain 105 days	4.6	9.3	12.4	10.6	10.4
Gain/dry food intake	0.52	0.79	0.99	1.16	1.01
Gain/protein intake	3.47	3.16	2.83	2.38	2.07

Results show that weight gains in fish fed pollock-based diets increased in direct relation to dietary protein levels up to 35%. A previous trial indicated that dietary protein contents above 35% did not support additional growth. Note that growth rate and efficiency of protein utilization of fish fed the 35% protein, 6% lipid content pollock-based diet were markedly superior to those of fish fed OMP (successful commercial diet 49% protein, 16% lipid). The moisture content of OMP per se seemed to have no effect on growth, although food utilization improved in fish fed freeze-dried OMP.

Results show that dietary protein content may be substantially decreased (lower costs) from recommended levels without concomitant reduction in food or protein utilization. Slightly modified pollock diets employed in this study may be applicable to culture of pinks and chums, especially at remote locations. A high performance diet not requiring refrigeration would be an asset.

For details contact: Ian McCallum, Dave Higgs
West Van. Lab. (926-4358).

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DATE May 19, 1981

MEMO NO. 29

CONTACTS

D. Alderdice, Pacific Biological Station
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Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Lab. - 5

SUBJECT - Fish Culture

Item - The salmonid egg as a vector of bacterial kidney disease.

It has long been suspected that salmonid eggs act as vectors of certain salmonid diseases, and the egg-mediated parent-to-progeny (vertical) transmission of bacterial kidney disease (BKD) is thought to be an important means by which this disease is maintained in salmonid populations. Until recently, however, direct evidence to indicate whether the responsible pathogen is carried both in and on the egg has been lacking.

Work carried out in this laboratory to examine the foregoing point has shown for the first time that the pathogen is indeed carried internally as well as externally by the egg. The studies also revealed that eggs constituting the greatest potential threat of infection came from females with cloudy (heavily infected) ovarian fluid. Eggs from such females should not be used for fish propagation because it has not been possible, using both internal and external egg-disinfection procedures, to free them completely of the viable pathogen.

Further studies are needed to determine the relative importance of the internally and externally carried pathogen in the vertical transmission of BKD and to evaluate the relative efficacies of procedures for disinfecting eggs internally and externally. It is now clear, however, that the risk of transmitting BKD with the egg is not entirely eliminated by egg disinfection. Egg disinfection does, however, severely reduce the infectious load that the eggs may be carrying; as a result, the procedure should prove effective, when used routinely, in reducing the prevalence of BKD in areas where the infection is already enzootic.

For further details contact: Trevor P. T. Evelyn
Pacific Biological Station, Nanaimo
(758-5202)

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DATE June 25, 1981

MEMO NO. 30

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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H. D. Smith - 2
A. Wood - 50
West Van. Lab. - 6
Pac. Biol. Stn. - 25

For further details contact:
P. Rombough
Pacific Biological Station, Nanaimo
(758-5202)

SUBJECT - Incubation of Salmonid Eggs

Item - Criteria for defining minimum acceptable dissolved oxygen levels for coho eggs

Coho eggs maintain a constant rate of O_2 uptake (V_{max}) at higher DO levels. As the environmental DO level declines (e.g. in a Heath stack), a point is reached where further decline in DO level results in reduced O_2 uptake by the egg. The DO level at which O_2 uptake rate just begins to diminish is called the critical DO level (P_c). P_c levels provide a basis for criteria defining minimum DO requirements since DO levels below P_c can result in a number of adverse consequences for the embryo, such as reduced growth and rate of development. P_c varies with species, stage of development and temperature. O_2 uptake data, including P_c, are being determined for several species. Preliminary results for coho eggs are summarized below.

Coho (10°C) Stage of development (T.U.)

	Fert'n (0)	(100)	Eyed (200)	(300)	Near hatch (440)
V_{max} (µg/egg/h)	0.1	0.4	2.0	8.0	18.0
P_c (mg/L)	<1.0	2.0	7.6	9.9	10.8

Prehatch Coho (435 T.U.)	TEMPERATURE (°C)					
	2.5	5.0	7.5	10.0	12.5	15.0
V_{max}	9.1	10.5	13.4	18.5	23.4	28.2
P_c	8.2	9.2	10.1	10.7	11.5	12.3

Changes in bulk velocity (100-3000 cm/h) did not significantly alter V_{max} or P_c, but at DO levels below P_c, rates of O_2 uptake were significantly greater at higher flow rates.

V_{max} can be used to predict DO levels of the perfusing water during incubation. We recommend that DO levels during incubation be maintained at levels above P_c. Note that temperature should not exceed 11°C for eggs near hatching since P_c is above air-saturation at higher temperatures.

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DATE July 20, 1981

MEMO NO. 31

CONTACTS

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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West Van. Lab. - 6
Pac. Biol. Stn. - 25

SUBJECT - Fish Culture

Item - Status of malachite green for fish disease treatment

Malachite green like many other synthetic dyes has been shown to be potentially hazardous to human health. Currently, it is not one of the few substances registered by the Food and Drug Administration for fishery use in the U.S.A. Nevertheless, it continues to be extensively employed worldwide for reasons of tradition, convenience and efficacy. Failure to register many traditionally-used chemicals does not necessarily imply that they are unsafe under conditions of use but only that they have not been subjected to the very expensive, time-consuming, and some say unrealistic tests necessary for their registration. Lack of registration may be from default not design. Because malachite green has been shown experimentally to have carcinogenic and mutagenic properties it probably would not be able to meet the particularly stringent registration requirements for food fish. Yet, health hazards associated with its use should be minimal when it is used under controlled conditions in salmon production hatcheries.

The use of chemicals in fish culture is not specifically regulated in Canada but Canadian fish pathologists tend to follow veterinary and/or U.S.A. fishery practice such as withdrawal even of registered treatment substances at least 21 days before food fish are slaughtered. Treatment of juvenile fish rarely presents a hazard to the consumer because there is usually ample time for the fish to eliminate ("clear") most medications from their bodies before they have grown to an edible size. However, because of the short clearance time ordinarily involved, it is recommended that adult fish treated with malachite green (or any substance such as 2-phenoxyethanol anesthetic that might leave a residue in the fish) not be used for human consumption. Further, personnel should avoid inhalation of malachite green powder (use a dust mask when handling) and prolonged and repeated exposure to the solution, even though malachite green has long been used medically as a topical antiseptic without apparent complications.

This laboratory will attempt via these memos to keep you informed of new developments relating to the uses and hazards of fish disease control chemicals.

For further details contact:
G. R. Bell
Pacific Biological Station
Nanaimo (758-5202)

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MEMO NO. 32

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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H. D. Smith - 2
A. Wood - 50
West Van. Lab. - 6
Pac. Biol. Stn. - 25

For further details contact:
G. R. Bell or
G. E. Hoskins (Nanaimo)

SUBJECT - Fish Culture

Item - Status of Ceratomyxa shasta in B.C.

The protozoan parasite Ceratomyxa shasta was first reported in B.C. in 1975 by Margolis and Evelyn who found the organism in juvenile chums in the ocean off Nanaimo. Subsequently we found C. shasta in adult chinook at the Big Qualicum and Capilano hatcheries and in a coho at the Quinsam hatchery, but the sporadic detection of infected fish did not give us cause for alarm. However, recent consistent findings of appreciable numbers of infected chinook, cutthroat and steelhead adults in the Fraser/Thomson system strongly suggest that the organism is enzootic in this system. Further investigation might show that the parasite is even more widely established in B.C. (C. shasta has been found in salmonids in the Columbia River and other areas of Oregon, Washington, Idaho and northern California.)

These findings are of particular significance to the establishment and success of chinook and other salmonid rearing facilities on the Fraser system because C. shasta has caused heavy losses of juveniles and pre-spawning adult salmonids in the U.S.A. Consideration must therefore be given to the presence of the infective stages of this potentially devastating organism in the siting, design and operation of proposed facilities.

Evidence from the U.S.A. indicates that there is no fish-to-fish transmission of the parasite but that exposure of susceptible fish for even 30 min to water containing the infective stage is sufficient to cause disease. Infective stages of the parasite are not uniformly distributed in a water body and, in fact, infected fish may exist in areas where no infective stages can be detected. (Infection rates and the progress of the disease increase with increasing temperature over 10°C.)

Species of salmonids differ in their susceptibility to the disease ceratomyxosis (as a general guide, in order of decreasing susceptibility: rainbow, cutthroat, chum, chinook, coho, sockeye, brook and brown trouts) but significantly so do strains of the same species.

There is no effective treatment for the disease. Disease in culture facilities may be prevented by the use of resistant strains of fish, non-infective water source, or treatment of influent by filtration and disinfection (e.g. ultraviolet light).

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 13 August 1981

MEMO NO. 33

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

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Pac. Biol. Stn. - 25

For further details contact:
Charles Lam
Rob Bams
Pac. Biol. Stn. (Nanaimo)
758-5202

SUBJECT - Water Quality, Japanese Style Facilities
Item - Gravel depth, loading density, water velocity

Effects of gravel depth (single layer vs 6-cm layer), loading density (6000, 12000, 24000 eggs/m^2), and bulk water velocity (40 vs 80 L/min), on chum egg development in keeper channels were studied at Rosewall Creek Hatchery. Dissolved oxygen (DO), pH, ammonia and nitrite were monitored. Mean diameter of gravel was 24 mm, (range 5-35 mm). A mixture of aerated well and stream water was used, maintaining a temperature of 8.06 $\pm$ 0.15°C. Size of the keeper channels was 8 $\times$ 0.8 $\times$ 0.15 m (L $\times$ W $\times$ D).

Results showed that DO was the main limiting factor; ammonia and nitrite did not reach critical levels. DO within the gravel in both low and high flow channels usually was below Davis's protection level "B", but above level "C". DO below level "C" was recorded more frequently in low flow than in high flow channels. Maximum deterioration of water quality occurred in 6-cm gravel layer sections where DO always was below level "C". Heavy aggregations of alevins at the inflows and outflows occurred in 24000 eggs/m^2 sections, but not at the lower densities, suggesting overloading at the higher density.

DO in water flowing above the gravel was higher than that within the gravel. The mean values of the ratio (DO within gravel / DO above gravel) $\times$ 100% were

high flow channel		low flow channel	
single layer	6-cm layer	single layer	6-cm layer
86.9%	62.3%	81.3%	54.3%

(e.g. in the high flow single layer case (above), DO in the gravel was 86.9% of DO above the gravel.) Hence flushing of gravel was most efficient in single layer sections of high flow channels.

DO in outflow water was higher than that within the gravel. The mean values of the ratio (DO within gravel / DO of outflow) $\times$ 100% were

high flow channel		low flow channel	
single layer	6-cm layer	single layer	6-cm layer
88.8%	63.9%	90.3%	59.8%

Hence outflow DO is not a good indicator of oxygen level in the gravel where the alevins are situated.

Conclusion: Ventilation of keeper channel gravel beds was more efficient in high bulk flow (80 L/min) single layer situations at loading densities below 24000 eggs/m^2. Outflow DO is not an appropriate indicator of oxygen concentration in the gravel environment holding the eggs; oxygen monitoring should occur within the gravel bed.

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INFO memo

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DATE August 7, 1981

MEMO NO. 34

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F. E. A. Wood - 52
West Van. Lab. - 6
Pac. Biol. Stn. - 25

For further details on this Info Memo contact:
M. Peters,
SEP Development,
1090 West Pender,
Vancouver, B.C.
V6E 2P1
(666-2796)

SUBJECT: The Pacific Region U.S. - Canada NEgotiating System (PRUNES)

Item: Computer based data and source files of catch numbers, proposed enhancement stock estimates, average landed and wholesale prices and catch and stock interception matrices for all five Pacific salmon species

PRUNES, in operation since 1979, comprises a seven-year catch base, from 1971-1977, for all Pacific Coast fisheries from Alaska down to California inclusive. Modifications are near completion to update the catch base to include 1978-1980 statistics and convert the existing system from imperial to metric.

This system has been designed to sort between all known area catches coastwide and identify the composition of stocks intercepted in each of the major fishery areas for each species and gear type.

One table, "The Stock Composition of Fishing Area Catch," indicates by percent and pieces the estimated portion of any stock caught in a given fishing area. An actual year's catch for any species, gear type and fishing area remains the same, but the catch is broken down to show the estimated stock composition of the fishery. Another table, "The Fishing Area Catch of Specific Stocks," summarizes all currently identifiable stocks and lists all fisheries to which the stock contributes. Enhancement and reallocation scenarios are also possible. The PRUNES base can be adjusted to reduce catches and/or enhance stocks in any fishery or coastwide, for any stock, in order to analyse the resultant changes should the management of fisheries be modified. This information is available in the form of printouts to all interested user groups.

As evaluation of the proposed U.S./Canada Agreement continues and S.E.P. begins its program plans for Phase II, P.R.U.N.E.S. will take a more prominent role in the assessment of fisheries management and enhancement opportunities.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 26 August 1981

MEMO NO. 35

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Pac. Biol. Stn. - 25

SUBJECT - Sockeye Culture

Item - Occurrence of Infectious Hematopoietic Necrosis (IHN)

Biologists and fish culturists interested in the intensive culture of sockeye salmon should be aware of the threatening virus disease, IHN. This disease is known to cause high losses among cultured and wild sockeye. The causative agent has a wide distribution within British Columbia. All runs of migrant sockeye adults tested so far contain infected individuals. The disease affects young fish primarily and past experience has shown that sac fry held under conditions of intensive culture are very susceptible. The disease was probably responsible for many of the losses in the early sockeye hatcheries in British Columbia.

In Oregon State and elsewhere, the disease is reported to affect steelhead, rainbow trout and chinook salmon, but in British Columbia the disease has not been observed in these species.

Since no effective control or treatment methods are known, it may be advisable to avoid large scale, intensive culture of this species until the disease can be prevented or controlled. At present, effect of the disease may be reduced by:

a) incubation of eggs and rearing of fish in virus-free water, i.e., disinfected, filtered or naturally free;
b) utilization of water containing no spawning or juvenile sockeye;
c) stripping of fish off-site and surface disinfection of eggs;
d) maintaining low egg densities in Heath tray and low pond densities of juveniles.

For further details contact: G. Hoskins
G. Traxler
(Nanaimo)

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DATE 26 August 1981

MEMO NO. 36

CONTACTS

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 25

SUBJECT - Premium diets for chinook salmon

Item - The effects of processing on herring meal quality

A consistent supply of good quality fish food is essential for the culture of salmon and trout in British Columbia. Fish meal is an integral component of commercial salmonid diets. The variable quality of fish meals currently used for diet manufacture is a function of the nature of raw fish employed before processing (origin, species, season, storage methods), processing methods (cooking, drying), and storage conditions of the dry meals.

A growth trial conducted on juvenile chinook at the West Vancouver laboratory in April and May, 1981, demonstrated the extent to which the quality of herring meal is dependent upon processing conditions.

Fish meals were prepared from one lot of fresh whole herring. All diets contained 40% crude protein, supplied exclusively by fish meal and 13% lipid. Weight gains over the 42-day test period were less by 13% and 72% for fish fed diets containing low temperature (75°C)-dried and high temperature (150°C)-dried meal respectively, compared to fish fed a diet prepared with raw freeze-dried meal. Similarly, fish weight gain per gram of food consumed decreased by 23% and 57% and the efficiency of protein utilization by 24% and 58%. Also, chemical tests revealed a loss of 11% and 18% of available lysine (a dietary essential amino acid) in the meals.

The results underline the need to secure a good local source of protein for inclusion in feeds for salmonid culture. Fish feed purchasers should specify that food manufacturers use only the very best quality fish meal and avoid the current practice of purchases based on brand names alone. Fish meal quality can be chemically defined by various criteria.

For further details contact: Ian McCallum
Dave Higgs
Jack Markert
West Vancouver Lab.
(926-4358)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 14 June 1982

MEMO NO. 37

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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West Van. Lab. - 6
Pac. Biol. Stn. - 25

SUBJECT - Disease Treatment

Item - Status of Benzalkonium Chloride for Disease Control

Products containing the quaternary ammonium compound, benzalkonium chloride (alkyl dimethyl benzyl ammonium chloride), such as Roccal, Hyamine 1662 and Hyamine 3500, are often listed in the literature as a treatment for bacterial gill disease and external parasites. Dosages between 1 to 2 ppm for 1 hour are commonly recommended.

This compound has proven to be highly toxic to salmonids in the soft coastal waters of British Columbia. Experiments at the Pacific Biological Station have shown that exposure to concentrations as low as 3.0 ppm for 1 hour can cause severe gill damage.

No products containing benzalkonium chloride should be used directly on fish in this Region because of the risk of gill damage. Instead, when faced with an outbreak of gill disease cautious use of potassium permanganate at 1.0 ppm for 30-60 min is recommended. Further, external parasites can be more effectively controlled with a combination of formalin and malachite green (25 ppm formalin + 0.1 ppm malachite green applied for up to 8 hours).

However, quaternary ammonium germicides are recommended for the routine disinfection of equipment and utensils ("bucket wash"). Care should be taken to ensure all surfaces are thoroughly rinsed with uncontaminated water before re-use or before allowing to dry. The recommended concentration for routine equipment disinfection is 1200 ppm active ingredient. A solution containing 600 ppm can be used to disinfect large circular, fiberglass tanks.

For more information contact: Gary Hoskins
Frank Dalziel
Pacific Biological Station
Nanaimo
(758-5202)

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INFO memo

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DATE 18 June 1982

MEMO NO. 38

CONTACTS

D. Alderdice, Pacific Biological Station
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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 25

SUBJECT - High quality practical dry diets for chinook salmon reared at warm water temperatures.

Item - Robertson Creek hatchery nutrition work.

In the spring of 1979, a nutrition experiment was conducted in pilot scale at Robertson Creek hatchery to evaluate the performance of juvenile chinook salmon fed one of two experimental West Vancouver dry (~10% moisture) diets or Oregon moist pellets (OMP; ~ 30% moisture). Triplicate groups of 10,000 chinook each were assigned to each dietary treatment. All diets were isonitrogenous and isocaloric. Water temperature ranged between 12.5 and 16.2°C. To evaluate ocean survival, triplicate treatment groups were pooled 7 days following conclusion of the 28-day feeding trial and were marked and tagged. All groups were simultaneously released into the ocean on June 2/79, 48 hr after tagging.

Table 1 shows release weights and preliminary return data for the 1978 brood salmon fed West Van 30 (WV30) or West Van 40 (WV40) dry diets or OMP during freshwater residency.

Treatment	Mean release weight (g)	No. tagged fish released	Return (no. of fish) hatchery 80 & 81	Return (no. of fish) fishery[1] 80 & 81
OMP	3.77	27,268	20	15
WV30	3.95	26,699	47	31
WV40	3.67	27,313	36	27

[1] Canadian fishery data only. In 1980, 23% of fish sampled while in 1981, 19% of fish sampled.

The above preliminary findings indicate that the return rates for chinook fed dry diets were almost (WV40) or slightly more (WV30) than double that of chinook fed OMP. Fish size and time of release were not confounding variables in this study. Therefore, under the cultural conditions employed at Robertson Creek hatchery it appears feasible to feed either WV30 or WV40 rather than OMP and expect excellent growth and survival.

For further details contact: Dianne Plotnikoff
Dave Higgs
West Vancouver Lab (926-4358)

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DATE July 26, 1982

MEMO NO. 39

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 52
West Van. Lab. - 6
Pac. Biol. Stn. - 25

For further details contact:
Ed Britton, Robertson Cr.H.
Bill McLean, Quinsam Hatchery
Chris Beggs, Robertson Cr.H.

SUBJECT - Incubation of Chinook Salmon in "Keeper Channels"
Item - Determination of suitable water flow & alevin density

Attempts are being made to incubate chinook salmon in "keeper channels" at Robertson Creek Hatchery. The concrete keeper channels are 1.9m wide and 11.6m long. The channel bottoms are covered with a single layer of rounded gravel ranging in size from 3.8cm to 5.1cm. Water depth, which averages about 9cm over the ground surface, is controlled by means of a stop-log at the pond outflow.

Experiments were performed on 1981 brood chinook to determine the optimum flow rates & densities for keeper channel operation. A simple two factor experiment was set up involving two levels of flow, 136 L/min (30 IGPM) & 273 L/min (60 IGPM) & three levels of loading density, (8000 eggs/m^2, 11,500 eggs/m^2, & 15,000 eggs/m^2). The six possible combinations of flow & density were established in separate keeper channels - facilities were not available for replication.

Crowding of alevins at the upstream end of the keeper channels was first apparent seven days after the beginning of hatch in the high density channels. The degree of crowding was density dependent & became more severe as hatch proceeded. Alevins piled on top of one another until they were about 6cm deep at the top of the channel. The lower layers suffocated & decomposed. Dissolved oxygen levels below 1.0 mg/L were frequently observed within the mass of alevins. While upstream movement occurred in every treatment, there was no suffocation in the low density - high flow channel.

Alevins were removed from overcrowded areas to prevent excessive mortalities due to suffocation & a subsequent loss of water quality as the bodies decomposed. The biomass removed from a channel was used as an indicator of the excess alevins or lack of living space in a channel.

In the following table the weight of alevins removed from each treatment is shown.

	DENSITY		
Flow	8,000/m^2	11,500/m^2	15,000/m^2
136 L/min	7.2 kg	15.7 kg	34.9 kg
273 L/min	0.0 kg	15.7 kg	35.1 kg

On-site observations indicate that either treatment at the lowest density will give satisfactory results. While the higher flow appears to be more desirable, lower flows may be applied in areas where water supply is limited.

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MEMO NO. 40

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Vancouver, B.C. 666-3855

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Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 25

NOTE: THIS REPORT IS NOW AVAILABLE THROUGH THE DFO LIBRARY AT 1090 W. PENDER, VANC.

SUBJECT - Salmon Quality

Item - Salmon Quality Considerations for Fisheries Management

In the Pacific Region, some wild stocks of salmonids are suffering from the impacts of mixed stock harvesting practices; additionally, the increased exploitation necessary to harvest some enhanced stocks may take a toll on weaker, unenhanced stocks. If the overall natural production from weaker, wild salmonid stocks is to be preserved, fishery managers may have to consider harvesting some stronger or enhanced stocks, or portions of them, in terminal fisheries.

This report presents preliminary salmon quality information which is prerequisite to the implementation of terminal fisheries. General criteria for grading salmon are presented for, and applied to, each of the five salmon species. The maturity of selected stocks at various locations has been described, pictures and maps graphically detail maturational characteristics and the areas where salmon undergo quality or grade changes, and tables list additional quality information for these, and other, stocks. A sampling program, conducted in 1981, yielded some especially interesting results when fish were canned: very mature fish were graded acceptable, the processing option of skin removal showed promise, and early-occurring rancidity indicated that the normally accepted storage time and temperature range of frozen fish may need to be reviewed.

Also discussed are relevant factors affecting the quality of fish after they are caught, the incidence of parasites, and possible conflicts concerning the use of terminal fisheries. (The federal government's Quality Improvement Program has specific implications for terminal fisheries, and there may be extra fish inspection and conservation requirements if fisheries are held in rivers.)

Additional programs are recommended to fill numerous information gaps, and some financial considerations of program implementation are presented.

For further details contact: Wayne Holmes
Victoria (566-3455)

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DATE September 7, 1982

MEMO NO. 41

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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

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Pac. Biol. Stn. - 30

For further details contact:

Bill Schouwenburg
Vancouver
(666-3856)

SUBJECT: Predation on Juvenile Salmonids

ITEM: Bird predation on juvenile salmonids in the Big Qualicum River estuary.

Studies conducted by Pamela M. Mace of U.B.C. during the period 1979-1981 indicated that predatory birds normally captured 10-12% (300,000) of enhanced chinook smolts and 2-4% of enhanced coho smolts released from the Qualicum hatchery. Under normal circumstances Bonaparte's Gulls account for the vast majority of this predation which takes place entirely within the extremely confined estuarine zone.

In 1981, when extensive fry blinding occurred, predatory birds took 1,000,000 chinook or 25% of the total release. Predation by Bonaparte's Gulls remained the same as in previous years, but Glaucous-Winged Gulls became the dominant predator, and Arctic Loons, Mergansers, Scoters, and Harlequin Ducks also became significant predators.

Bonaparte's Gulls are very efficient predators on hatchery smolts. Up to 33% of their attempts to catch coho succeed and up to 93% of their attempts to catch chinook succeed. When small numbers of chinook are present, these gulls can catch up to 95% of the fry.

It is clear that the effectiveness of this predation has been aided by hatchery release procedures. The author has suggested the following modifications to release procedures to reduce predator effectiveness:

1. Delay fry release.
2. Release fry to coincide with high tides.
3. Release fry late in the day.
4. Force fish out of the hatchery.
5. Release fry coincident with nearby hatcheries.

Physical changes such as dredging the river channel and providing artificial protective cover were also identified as ways to control predator effectiveness; however, releases timed to bad weather will not help, nor will predator control programs. Predator effectiveness will be a site-specific consideration.

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West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

G. Ladouceur
Big Qualicum
(757-8412)

T. Perry
Vancouver
(666-1287)

SUBJECT: Predation on Juvenile Salmonids
ITEM: Bird predation on Big Qualicum hatchery-released chinook salmon in the estuary.

Studies by Pamela Mace (UBC) in 1979-1981 demonstrated that piscivorous birds took a large number of chinook and smaller numbers of coho and chum following release from the Big Qualicum hatchery and spawning channel facilities. (See INFO MEMO #41)

In 1982 hatchery staff changed the release strategy to reduce bird predation on chinook. Changes, and rationale for these changes, were:

1. delayed release date from late May/mid June to June 11 and later to avoid migratory species such as Arctic Loons.
2. release at dusk on a date when tides were high the following morning and low in the afternoon but no extreme low tides would be encountered for the next 3-4 days. This minimized the success rate of Bonaparte's gulls which feed most effectively when tide height is less than 3 m.
3. forced outmigration of fish remaining in raceways after several days volitional migration. This reduced the time period of high chinook density in the estuary.

The release strategy worked: Mace and Big Qualicum staff monitored bird populations and their feeding success from June 11 to 24. A combination of lower bird numbers during chinook outmigration, reduced feeding opportunity and reduced attack-success rate in 1982 resulted in greatly reduced chinook predation. Losses in 1980 are considered to be a control for 1982; however, 1981 losses were exceptionally high due to cataract disease among chinook fingerlings. Refinement of release methods may further reduce chinook mortality in the estuary.

Estimated losses of Big Qualicum chinook fingerlings to the major predatory bird species in the estuary.

	1979	1980	1981	1982
Total predation	>221,000	311,000	851,000	<48,000
Chinook release	2,539,000	2,896,000	4,335,000	3,821,000

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE September 7, 1982

MEMO NO. 43

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 25
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

NOTE: ALL REPORTS IN THE BIBLIOGRAPHY ARE NOW AVAILABLE ON LOAN FROM THE PBS LIBRARY AT NANAIMO OR FROM THE DFO LIBRARY AT 1090 WEST PENDER, VANCOUVER.

SUBJECT - Biological Reconnaissance

Item - Review of studies done in support of new SEP Enhancement Operations facilities

To date in SEP Phase I, the New Projects Unit has funded studies on approximately 50 systems throughout B.C., with the production of some 30 in-house reports:

AREA, SYSTEMS, (YRS OF STUDY)	NO. OF REPTS* JUVEN	ADULT
NORTH COAST:		
Dala/Kildala/Bish Estuaries (1)	1C	-
Gardner Canal Streams (1)	-	1C
Kemano R (1)	-	1C
Kitimat R/tribs (2)	2C	-
Mathers Cr (4)	2D/1C	2D/1C
Pallant Cr (2)	2D	2D
SOUTH COAST:		
Kakweiken R(1)	-	1C
Knight Inlet Streams (1)	-	2C
L.Qualicum R (1)	1C	1C
Nitinat R (1)	1D	1C
Tlupana Inlet Streams (1)	1C	1C
FRASER RIVER:		
Blackwater/ Cottonwood R (1)	-	1C
Bowron/Willow R (1)	1C	1C
Horsefly/ Nechako R (1)	1C	1C
N.Thompson R / tribs (1)	1C	1C
Quesnel R (2)	2C	2C
Slim Cr (1)	-	1C
U.Fraser tribs (1)	1C	-

*C=consultant; D=Departmental

These reports examine water quality, temperatures, and flows; timings, distributions, and population characteristics of adult and migrant/rearing juvenile salmonids; and biophysical spawning and rearing capabilities. (A complete bibliography of these reports is available at the libraries mentioned below.)

In addition, three reports reviewing the available data for the Quesnel, Nechako and Kitimat watersheds have been completed, and there were SEP-funded studies done on the Blackwater, Cottonwood, Morice and Kalum systems by other DFO groups (reports not yet available). Juvenile studies on the North and South Thompson systems are ongoing in 1982/83.

An initiative has been started to improve communications regarding ongoing and planned fieldwork. Those interested in a bioreconnaissance users' committee or in receiving a fieldwork bulletin are asked to contact Bruce Shepherd, Vancouver (666-1115).

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INFO memo

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DATE September 7, 1982

MEMO NO. 44

CONTACTS

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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
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West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

Ted Perry (666-1287) or
Bruce Shepherd
(666-1115)
Vancouver

NOTE: THIS REPORT IS NOW AVAILABLE ON LOAN FROM THE PBS LIBRARY AT NANAIMO OR FROM THE DFO LIBRARY AT 1090 WEST PENDER, VANCOUVER.

SUBJECT - Juvenile Production, Hatcheries

Item - Effects of enhancement strategies on the homing, straying and survival of Pacific salmonids.

Much of SEP's production requires importing stocks to a central site for incubation and rearing, and then releasing those stocks into their native streams. Central hatcheries thus may be able to enhance stream-specific adult returns while retaining economy of scale. It is fundamental to this strategy that adults return to their native streams and not to the hatchery. The lack of supportive data prompted a state-of-the-art review of published and unpublished data from all Pacific Northwest agencies undertaken for SEP by D.B. Lister and Associates Ltd. We hoped this review would tell us how to locate and operate central hatcheries successfully, but most of the available data were inapplicable or inconsistent. However, some general conclusions were drawn:

1. Within-system smolt releases at locations other than the rearing site (off-station releases) result in more straying than smolt releases made directly from the rearing site.
2. The rate of straying for off-station releases decreases with increasing distance between the release site and hatchery.
3. Releases to other watersheds are less likely to stray than within-system releases.
4. Straying to the hatchery is a significant portion of total straying.
5. Smolts released off-station can survive at rates comparable to hatchery-released smolts.
6. Guidelines to maximize imprinting for off-station releases are not known.

The review also made general recommendations regarding hatchery water supply, release locations relative to hatchery location, age of fish at release, and necessary research. Applied studies are now in progress at all major central hatcheries in B.C.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE November 5, 1982

MEMO NO. 45

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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For further details contact:

Don MacDonald
Bruce Shepherd

Vancouver (666-1115)

SUBJECT - Incubation of Salmonid Eggs

Item - Water temperature and developmental timing

Although the incubation period of salmonids in nature is influenced by environmental factors such as oxygen level and water flow, artificial incubation techniques tend to minimize these effects, leaving temperature as the primary determinant of the embryonic developmental rate.

B.C. hatcheries routinely use an accumulated temperature unit (ATU) approach to predict timing of eyed, hatch and emergent stages. Although some intuitive adjustment of ATUs is done for 'early' and 'late' segments of stocks, this approach assumes the temperature in °C multiplied by the time in days to be constant regardless of the thermal regime. Unusually early emergence of Slim Creek chinook at the Upper Fraser Penny facility prompted collation and analysis of coastwide data, in order to increase predictive capability for new projects.

The following regression equations were developed from the available data (there are insufficient data for pink salmon, or for the eyed stage of all species) and should improve predictive accuracy:

Species	Peak Hatch	r	Peak Emergence	r
Chinook	$\ln D = -.12T + 5.2$	-0.979	$\ln D = -.14\ T + 5.9$	-0.942
Coho	$\ln D = -.18T + 5.4$	-0.969	$\ln D = -.14\ T + 5.7$	-0.965
Chum	$\ln D = -.11T + 5.1$	-0.915	$\ln D = -.11\ T + 5.7$	-0.956
Sockeye	$\ln D = -.11T + 5.3$	-0.960	$\ln D = -.12\ T + 5.8$	-0.982

(Where D = time in days and T = mean temperature for period in °C.)

It is cautioned that these equations do not fully describe the relationship and that their use requires iteration when seasonal water temperature variations are large. We therefore have prepared a set of reference tables (available on request) which more accurately relate the developmental rate of each species to ATUs over a range of mean temperatures.

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Pac. Biol. Stn. - 30

For further details contact:

Gordon McIntyre
(666-2752)
Vancouver

Dave Peacock
(627-9137)
Prince Rupert

SUBJECT - Kitimat Arm Chinook Tagging Update

Item - Chinook Populations and Sport Fishing Parameters of Kitimat Arm

Chinook rearing in the Kitimat Arm/Douglas Channel area were studied by Beak Consultants using a mark-recapture method to estimate population size and a creel census to evaluate the sport fishery. Floy tags were applied to 1427 chinook (mostly age 2_1 fish). Sport fish recaptures resulted in a Petersen population estimate of 55,000. Coded-wire tag data and scale analysis indicated that 5% of these fish were from the Kitimat pilot hatchery, 53% were from other Canadian hatcheries and the rest were wild fish or American hatchery fish.

During the summer of 1980, sport fishing mortality was 9,600 fish or 17% of the population under investigation. Approximately one-third of this loss, or 3,000 fish, was due to shaker mortality. In the same period, the Area 6 commercial net fishery took about 4% of the 2-yr. olds rearing in the inlet.

During their first ocean year, 98% of the Kitimat hatchery chinook perish or leave the inlet. In 1981, 10% of the coded-wire tag recoveries of these hatchery fish were taken in the local sport fishery, 40% in Canadian commercial fisheries and 50% in the Alaska troll fishery. Tagging indicates immature chinook rear in inlet headwaters during the winter and spring and move gradually to the outer coast during the summer. A few chinook remain near their native streams but most migrate north along the coast, using rearing habitat in many coastal inlets. The population of young chinook in the study area consists of local stocks and migrants from more southerly areas. These young fish appear to be highly mobile, with substantial immigration to and emigration from the Kitimat Arm area.

Technical and data reports (as per Item, above) by Emily Oguss, Beak Consultants, will be available soon.

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Pac. Biol. Stn. - 30

For further details contact:

R. Stitt, Chehalis (796-2281)
C. Beggs, Puntledge (338-7444)
D. Lawseth, Robertson (724-6521)

SUBJECT - Bio-rings as an incubation medium

Item - Koch Flexi-rings as a medium in free style boxes

At Robertson Creek Hatchery, Koch flexi-rings (bio-rings) were used to incubate chinook alevins to the button-up stage. Bio-rings were loaded into 4 upwelling free-style incubation boxes, 62 cm. w x 79 cm. l x 43 cm. d. Two sizes of bio-rings and three loading densities were used (see table). The boxes were set up in tandem with a flow of 70 l/min. Preliminary results are summarized below:

Free Style Box	Bio-Ring Size	Total No.	Density (alevins/cc.)	Ponding ATU's	Ponding Size	Estimated % Mortality
1	3.8 cm	180,000	0.903	922	0.57/gm.	30
2	3.8 cm	150,000	0.75	951	0.59/gm.	<1
3	2.5 cm	100,000	0.516	1025	0.60/gm.	5
4	2.5 cm	100,000	0.516	991	0.63/gm.	<1

Box #1 had high moralities due to operational difficulties and because alevins were severely stressed before the experiment began. Also, there was a premature migration of 15,000 alevins at approx. 860 ATUs; other boxes experienced minimal premature migration. Only box #3 had volitional migration, occurring at approx. 1025 ATUs. Fry in other boxes were removed manually just before button-up.

Advantages of bio-ring incubation are:
-volitional migration possible; small floor space requirement; water conservative; deformed fry if any remain in the box; bio-rings are light and easy to clean; floating bio-rings make fry removal easy.

Disadvantages are: initially bio-rings are expensive ($22.00/0.028m^3), and alevins cannot be observed during incubation.

In summary, bio-rings appear to produce good quality fry. Larger bio-rings allow about 3% more space and are slightly easier to clean. More data are needed regarding longer term effects of this type of incubator on fry and in determining optimal loading densities.

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INFO memo

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DATE February 1, 1983

MEMO NO. 48

CONTACTS

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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

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Pac. Biol. Stn. - 30

For further details contact:

Doug Turvey
Harry Genoe
Bill McLean
Puntledge Hatchery
(338-7444)

SUBJECT - Egg Disinfection.

Item - Disinfection with Ovadine using a varistaltic pump at Puntledge Hatchery.

Disinfection of the 1981 brood coho eggs was carried out in an attempt to reduce loss of fry due to furunculosis. In past years severe outbreaks have occurred during the high temperature summer months. Disinfection was done 15-20 hours after fertilization by pumping Ovadine disinfectant into the top Heath tray using a varistaltic pump. Pumping eliminates excessive handling and can be done when the eggs are sensitive to shock. A second treatment was given just after first pick.

Ovadine was pumped into the Heath trays for 15 minutes to obtain a desired exposure of 100 mg/l for 10 minutes. To reduce costs, the Heath trays were loaded vertically over two eight-tier stacks. At the time of disinfection the flow to the bottom stack was shut off and a trough was used to divert the flow from the top 8 trays to the bottom stack. In addition, the flow to the top stack was reduced from 12 l/min. to 6 l/min. Using these two methods the final cost was $5.37 per treatment of a double stack.

A group of 100,000 eggs was not disinfected for later comparison with 50,000 treated eggs from the same egg-take. Both groups were reared under similar conditions in Capilano troughs. After two months the disinfected eggs had 11.4% mortality as compared to 19.2% in the non-disinfected group. These results were encouraging but not conclusive, as experimental groups were not taken from pooled eggs.

To date (Sept. 82) overall juvenile mortality due to furunculosis has not decreased significantly as compared to previous years. However, it should be noted that 1981 adults were heavily infected with furunculosis. Also, treatment of juveniles with antibotics has been reduced this year. Mortality from ponding to September 6 was: 1981 brood, 16.3%; 1980 brood, 12.5%; 1979 brood, 14.7%.

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DATE February 1, 1983

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 30

For further details contact:

Ed Britton,
Robertson Creek
Hatchery
(724-6521)

SUBJECT - Anesthetizing Adult Salmon

Item - Constant carbon dioxide (CO_2) and oxygen (O_2) aeration to anesthetize adult salmon.

An improved method of anesthetizing brood stock salmon in high concentrations of dissolved CO_2 gas has been developed at Robertson Creek Hatchery. Previously, problems associated with this technique included low dissolved O_2 levels and rapid reduction in dissolved CO_2 levels as the anesthetic was used (later groups were poorly anesthetized). This necessitated frequent recharging of the tank with fresh water and CO_2.

The following procedure can be used to anesthetize up to 1,000 adult salmon (50 salmon x 20 loads) after a single charge (with maintenance level charging).

The anesthetic tank measures 2 m x 2 m x 0.84 m deep, holds 3.36 m^3 water, and is charged with CO_2 by forcing the gas through a large carborundum stone in the bottom of the tank. Charge time is 30 minutes at 150 psi. A CO_2 concentration of 350-450 mg/l is reached. This reduces the dissolved O_2 from 10 mg/l to 7-8 mg/l. Partial restoration of O_2 is achieved by aeration with O_2 at 10 psi during the last 5 minutes of the CO_2 charge so that the dissolved O_2 concentration at the beginning of the sort is 8-9 mg/l. The pH is adjusted to > 6 with sodium bicarbonate (2-3 kg). During the sort, the anesthetic tank is continuously charged at maintenance levels of 85-100 psi CO_2 and 10 psi O_2.

In the initial experiment conducted on October 9, 1982, 405 coho and chinook were anesthetized in 12 loads. Initial gas concentrations were: CO_2 - 363 mg/l; O_2 - 7.9 mg/l. Concentrations after loading were: CO_2 - 285 mg/l; O_2 - 8.4 mg/l. Exposure was 4.0 minutes from first to last load. Dissolved gas levels are typically 220 mg/l CO_2 and 9.5 mg/l O_2 after these large loads. Since response of salmon to levels below 200 mg/l CO_2 is less than optimal and the water is very murky after 1,000 adults, this is probably near the maximum for a single charge of the tank.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE January 6, 1983.

MEMO NO. 50

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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SUBJECT - Acid Sensitivity of Pacific Salmon

Item - Tolerance of eggs and alevins to low environmental pH

Ten-day bioassays were conducted to assess the sensitivity to low pH of eyed embryos, newly hatched alevins and buttoned-up alevins of coho, chinook, sockeye, pink and chum. There were significant differences in the acid sensitivities of the various life stages and species. Buttoned-up alevins were the most sensitive and eyed embryos the least sensitive stage of all species except coho. Newly hatched alevins were the most sensitive stage for coho. The relative sensitivities of the various species were ranked: chum > pink > sockeye > chinook > coho for eyed embryos and buttoned-up alevins. This order was reversed for newly hatched alevins. Levels of pH that caused 10% mortality (10-d LC10) among eyed embryos and the more sensitive of the two alevin stages tested are listed below.

	10-d LC10 pH values	
Species	Embryo	Alevin
Chum	4.19	5.74
Pink	4.13	5.35
Sockeye	3.97	5.25
Chinook	3.82	5.08
Coho	3.90	5.01

There was no sign of a toxic threshold after 10 d and significant mortality would be expected at even higher levels of pH than those tabled with longer exposures. In addition, behavioral changes likely to reduce survival in the wild were noted in pink and chum at pH 6.0-6.1. These results indicate that Pacific salmon are extremely sensitive to environmental acidification.

For further details contact:
P. Rombough
Pacific Biological Station
Nanaimo, B.C.
756-7004

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INFO memo

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DATE February 1, 1983

MEMO NO. 51

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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For further details contact:

D. Turvey
H.S. Genoe
Puntledge Hatchery
(338-7444)

SUBJECT - Fish Culture Anesthesia.

ITEM - Introducing carbon dioxide (CO_2) anesthesia via Micro-Por tubing.

To reduce the initial charge time of an anesthetic tank (2,000 l), CO_2 was introduced using Micro-Por tubing rather than the standard 165 cm carbon stone. Oxygen was introduced into the tank in the same manner, but with a separate line.

The tubing was fastened to an aluminum frame in a circular fashion to cover as much of the bottom area as possible. The CO_2 was introduced via 11.3 meters of tubing and the oxygen through 7.9 meters of tubing. Stopcocks were fastened to the end of each line for drainage purposes. This eliminated freeze-up problems when carbon stones were left in the tank while the gas was turned off.

At a flow of 55 cfh and using a 165 cm carbon stone, it took 25-30 minutes to obtain a concentration of 300-330 mg/l in a 2,000 l tank. When the same flow was used with Micro-Por tubing, the time was reduced to 13-17 minutes to obtain the same concentration. The decrease in time is primarily due to the added surface area of the tubing. Once the desired concentration was reached, this level was maintained by trickling CO_2 in at 10 cfh. (See Info Memo #49: maintenance level O_2 at 5 cfh.) Cost of the Micro-Por tubing vs carbon stones is:

Micro-Por tubing (30.5 m - 100 foot roll)	$131.25	single roll
	$111.57	- 4 or more
11.3 m of tubing	$ 48.56	
Carbon stone	$ 58.55	
	$ 52.05	- 2 or more

* Prices in U.S. funds as of Dec. 82

The Micro-Por tubing is relatively easy to work with but should be protected from damage (i.e. thrashing fish) by putting it under screens lying on the bottom of the anesthetic tank.

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Pac. Biol. Stn. - 30

For further details contact:

Brian Olund
Conuma River Hatchery
Dial: Vancouver Radio Operator 711
Ask for: N710-215

SUBJECT - Alevin Mortality in Keeper Channels.

ITEM - A method to estimate alevin mortality in keeper channels.

Alevin mortality in keeper channels is difficult to estimate because of differences in alevin distribution and the state of decomposition of the dead alevins in the gravel. At Conuma River Hatchery a method of subsampling the gravel was tested.

After the fingerlings had moved out of the keeper channels, the channels were drained. A plastic bucket was placed over the substrate, and the gravel on the outside of the bucket was cleared away. The bucket was removed, and the alevins or remains within the sample area were counted by carefully removing the gravel. (Usually a piece of yolk sack was all that remained of a dead alevin.)

Several samples were taken along the length of the channel with more samples taken in areas of suspected high alevin mortality. In a sample area of 314 cm^2 (the area of the bucket), dead alevins numbered 33; 65; and 24 in 3 samples taken in the first m of the channel and 17; 9; 6; 8; 11; 6; 3; 5; 4; 4; 3; and 4 in 12 samples taken in the last 32 m of the channel. The area at the head of the channel (first m) had an average of 339 mortalities/m^2, and in the last 32 m there was an average of 64 mortalities/m^2.

The advantage of the subsample method is that it allows a careful examination of the gravel. It was found that there was not a large variation in mortalities between channels (1 - 3%), even though the channels looked different in terms of alevin activity and alevin crowding towards the head screen. The mortality was also very poorly correlated to alevin density in the channel. We suggest that a proper evaluation of keeper channel performance should involve measuring fry quality at emergence, in addition to alevin mortality.

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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

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Victoria, B.C. 387-1961

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For further details contact:

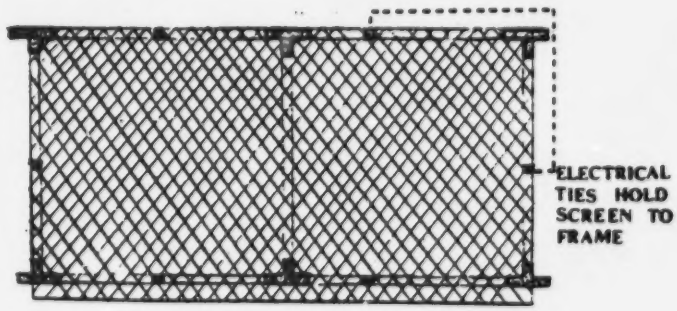
I. McLean
B. Olund
Conuma River Hatchery
Dial: Vancouver Radio Operator - 711
Ask for: N71-0215

SUBJECT - Keeper channel screens.

ITEM - Lightweight PVC keeper channel screens.

In Japanese style chum salmon hatcheries, keeper channel screens are used to hold the eggs above the substrate. Once the alevins hatch, they swim through the screen and into the gravel. At Conuma River Hatchery, we use a durable, lightweight keeper channel screen which is built with a PVC pipe frame.

Materials included vexar screen, six electrical ties, PVC (1.9 cm) schedule 40, and 6T joints. Construction time was 30 mins.



The pipes are held in the T-joints by friction fit; no glue is necessary. The screens are held above the gravel on aluminum angles which are fastened with bolts to the concrete sides of the channels. If there are no angles, PVC can be used as legs by attaching short pieces of the pipe to the T-joints at the corners of the screen. The height of the screen above the gravel is determined by the length of the legs. This style screen can be easily constructed to fit any size of rearing channel. The ends of the pipes are left open to allow the frame to flood, weighing the screen down.

These screens, in use since 1979/80 at Conuma River, have proven to be a practical, inexpensive alternative to steel or aluminum screens.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 1, 1983

MEMO NO. 54

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

T. Kyte
G. Ladouceur
M. Westcott
Big Qualicum Hatchery
(757-8412)

SUBJECT - Increased Chinook Egg Mortality.

ITEM - Effect of egg take procedures on egg survival.

During the last few years, there has been a trend toward increased incubation mortality (particularly in chinook salmon) at some B.C. hatcheries. This trend has created much speculation about the cause. Decreased viability of gametes from "domesticated" brood stock is one favourite theory, but another is that egg take methods may play a much more important role on survival.

Therefore, to determine the impact of egg take methods on survival, a renewed effort was made to improve procedures during the 1982 egg take program at Big Qualicum Hatchery. Both male and female gametes were more closely protected against contamination and physical or temperature shock. Procedures were carried out much more carefully and with more consideration toward their effects on egg survival.

Eyed chinook egg mortalities at Big Qualicum River for the last four years are summarized below:

BROOD YEAR	NO. OF EGGS	% MORTALITY TO EYED STAGE
1979	6.5 M	6.8
1980	7.0 M	10.2
1981	7.2 M	14.6
1982	6.0 M	5.7

The extra care taken during spawning and fertilization of 1982 brood chinook resulted in increased fry production and reduced manpower needed for egg picking. Indications are that further refinement of egg take procedures will increase survival.

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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

M. Westcott
G. Ladouceur
T. Kyte
Big Qualicum Hatchery
(757-8412)

SUBJECT - Predation on Chum Fry.

ITEM - Coho smolt predation on Big Qualicum River (BQR) chum fry.

Flow control and a spawning channel on the BQR system markedly increased chum egg-to-fry survival. Adult production increased, but not in proportion to the increased fry production. Fry-to-adult survival decreased over the last few years and could be the result of several factors. However, when chum fry-to-adult survival is compared with hatchery coho smolt releases, there is a trend of lower chum survival with increased coho smolt production.

Coho production began at BQR in 1968 and corresponds to the start of the decrease in chum fry-to-adult survival. Heavy predation on chum fry by these hatchery produced coho smolts has been observed at BQR in recent years.

To evaluate the effect these smolts (av. wt. 18 g) have on chum fry, we calculated the weight of food that coho could eat over an interaction period of two weeks and divided this by chum fry weight (av. 0.40 g). We assumed a water temperature of 9° C and a feed rate of 100% on an OMP schedule.

Estimated Consumption of Chum Fry by Coho Smolts at Big Qualicum

Release Year	Coho Smolts	Estimated Consumption of Fry
1970	69,000	95,000
1976	672,000	10 M
1981	1.5 M	21 M

These numbers show that coho smolts could eat up to 40% of the annual chum fry production at Big Qualicum before the fry reach the sea. Therefore, the timing of hatchery smolt release becomes a critical factor in chum survival.

To reduce interaction time, we now release smolts 2 to 3 weeks after the peak migration of chum fry. First indications of the results of altered release time will be known by fall, 1984.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 1, 1983

MEMO NO. 56

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

I. McLean
B. Olund
Conuma River Hatchery
Dial: Vancouver Radio Operator - 711
Ask for: N71-0215

SUBJECT - Instream Fences For Adult Salmon.

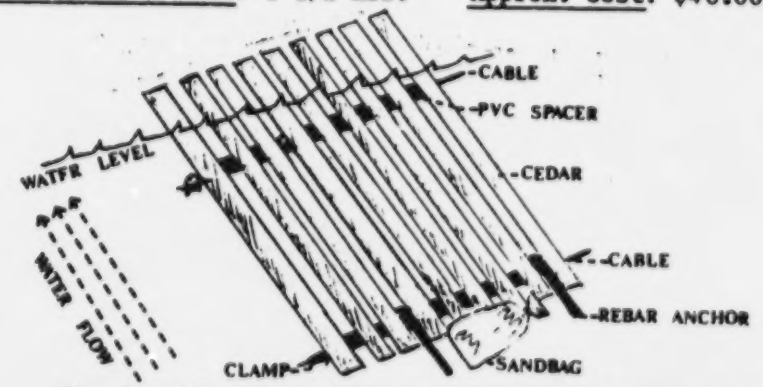
ITEM - A floating salmon fence.

Broomstick fences are often used to hold a percentage of broodstock from going upstream. On the west coast of Vancouver Island, many streams swell with sudden peak flows making it difficult to hold a broomstick fence in place. At Conuma River Hatchery, we use a floating fence which adjusts its height to the level of the river and can be built in 3 m sections and dismantled for transport.

Materials for construction of a 3 m (10') section:

- Cedar 2x2 rough cut 3 m (10') long; drill to pass cable through
- 1.8 m (6') of cable
- Sandbags
- 5 cm (2") PVC for spacers between cedar
- 2 cable clamps
- Iron rebar 1.25 cm (1/2") diameter

Construction time: 1 1/2 hrs. Approx. Cost: $40.00



The length of cut PVC pipe determines the width of spaces between cedar 2x2's and should vary according to the size of the species to be retained. The fence is held on the river bottom by rebar which is pounded into the river bed and bent over the bottom support cable of the fence. Sandbags placed on the upstream side of the fence weigh it down.

The main advantage of using this floating fence in the debris laden streams of the west coast is that it will lean to allow passage of large logs.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 22, 1983

MEMO NO. 57

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

P.G. Lim, Vancouver (925-2271)

D.T. Barrett, Vancouver (666-3909)

SUBJECT - Salmonid Transplants.

ITEM - A review of pink salmon (Oncorhynchus gorbuscha) transplants to Robertson Creek (1959 - 1964).

An artificial spawning channel was built on Robertson Creek in 1959. One of the primary objectives of the channel was to establish a commercial-sized run of pink salmon (O. gorbuscha) in the upper Somass River and to increase the numbers of coho (O. kisutch) and chinook (O. tshawytscha) salmon. Massive pink salmon egg transplants from various B.C. sources ensued with variable, but overall poor results. Egg-to-fry survival was excellent, ranging from 86 to 95 percent, but adult returns, good one year, were dismally poor in others during the period 1961 to 1967. The project was "mothballed" until 1971 when the Department of Fisheries and Forestry (now Fisheries and Oceans) converted the site to an enormously successful chinook, coho, and steelhead trout (Salmo gairdneri) hatchery which continues to operate at high production levels today.

This paper reviews the data gathered from 1960 to 1967 on the pink egg transplant experiments at Robertson Creek. Previously presented information, that found in literature, and perhaps, most important, that gleaned from personal communication with people who were directly involved with the project, are reviewed. Reasons for failure were found to be academic to the problem of establishing pinks in a stream previously barren of that species. Some problems unique to Robertson Creek are its warm temperature, long distance to the sea, proximity to a pulp mill, and presence of many fish species which prey on migrating fry.

This is a summary of a soon-to-be-released Manuscript Report which will be available, on loan, in local DFO libraries.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE January 25, 1983

MEMO NO. 58

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 25
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F. E. A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

SUBJECT - Fertilization of salmonid eggs

Item - Prevention of infertility due to broken eggs.

Infertility caused by broken eggs in batches of salmonid ova is a problem. Rinsing the batches in a salt solution can improve fertility but the technique is not standardized.

We evaluated fertility in coho salmon eggs using 3 isotonic solutions (NaCl, pH = 9.0; $NaHCO_3$, pH = 8.4; artificial ovarian fluid (AOF) pH = 8.4) as rinsing agents prior to fertilization. Batches of eggs containing 1%, 3%, and 9% broken eggs were rinsed for 1 min, 10 min, and 30 min with each solution. Additionally, control groups were fertilized without applying a rinsing procedure.

Effect of broken eggs and rinsing on fertility

	Fertility			
% broken eggs	Control	NaCl	$NaHCO_3$	AOF
0	93.3	-	-	-
1	39.5	94.2	93.5	95.9
3	2.2	92.7	95.3	96.3
9	1.1	95.4	93.3	92.6

The presence of broken eggs reduces fertility drastically. Rinsing of these eggs for 1 to 30 min, prior to insemination, restored fertility. The results were independent of the time exposed to the rinsing agent and the percentage of broken eggs. We observed that ovarian fluid contaminated with the egg material loses it's ability to induce motility in sperm cells. Thus infertility is likely due to the immobilized sperm cells.

We suggest testing the rinsing of batches in production hatcheries where broken eggs are a problem. A solution of 14 g of $NaHCO_3$ per liter of water is inexpensive and the easiest of the 3 solutions to make.

For further details contact: Kelly Wilcox
~~Joachim Stoss~~
West Vancouver Lab (926-4358)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 3, 1983

MEMO NO. 59

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F. E. A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

SUBJECT - Dietary lipid sources for juvenile coho salmon cultured in fresh water.

Item - Canola oil and pork lard versus herring oil.

Canola oil (C), pork lard (L), and herring oil (H), singly and as equal blends were assessed as supplemental sources of dietary lipid for juvenile coho salmon held at 10-12°C on a natural photoperiod over an 84-day period. Each of the six different types of supplemental lipid constituted about 56% of the lipid content (15% of dry matter) in the West Van 1 (WV1) dry diet. Some groups received Oregon moist pellets (OMP). All groups were fed twice daily to satiation.

Relative to coho fed WV1 with marine oil alone, type of supplemental lipid did not influence coho growth, food, protein and energy utilization, body proximate composition, fish health and survival, or the histological structure of selected organs. The growth rates of coho fed WV1 supplemented with H, C, or H-L were equivalent to those of coho fed OMP. Body lipid composition mirrored that of dietary lipids except levels of saturated and unsaturated fatty acids showed less variation than those in dietary lipids.

It is concluded that canola oil, pork lard and a blend of these lipid sources are excellent alternative types of supplemental lipid for coho salmon under our test conditions. They are more available, often less expensive and less prone to oxidation than marine oil.

For further deatils contact: Bakhshish Dosanjh
Dave Higgs
West Vancouver Lab
(926-4358)

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 22, 1983

MEMO NO. 60

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:

R. Kadowaki

J. Roussy
North Coast Management
Biology Unit
Prince Rupert
(627-8730)

SUBJECT - Adult Chinook Tagging.

ITEM - Results of chinook tagging conducted in conjunction with the U.S./Canada tagging program.

A total of 609 adult chinook were tagged by chartered seine vessels during the 1982 U.S./Canada tagging program. Although sockeye and pink were the species of interest, very early in the program the charter skippers discovered that there was an opportunity to tag incidentally caught chinook with domestic Petersen tags. No special recovery arrangements were made; however, 69 tags (11.3% recovery rate) were turned in by commercial, sport, and native food fishermen as well as D.F.O. staff in the W.C.V.I. area. Interpretation of the results is complicated by a number of factors such as: 1) lack of stream recoveries, 2) passivity of the commercial and sport recovery system, 3) disproportionate distribution of tagging + recovery effort, and 4) small numbers of tags applied and recovered. The following table summarizes the data collected.

		NO. RECOVERED				
Tagging Location	No. Tagged	Areas 3-4	Areas 6-10	W.C.V.I.	Others	Total
Langara	296	2	2	9	12	25
Muzon	10	1				1
Dundas	122	8	4	2	3	17
Portland	59	6			1	7
Bernie I.	55	9			1	10
Porcher	62	8	1			9
Other	5					0
Total	609	34	7	11	17	69

From this data, the only significant movement discernible is from Langara Island to the West Coast of Vancouver Island; however, the intensive fisheries and hatchery in this area probably biased the relative number of those recoveries.

No further analysis will be carried out in the immediate future but the raw data are available to anyone who wishes it.

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NI memo

For internal, informal, rapid exchange of information between data producers & users.

DATE March 1, 1983

MEMO NO. 61

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 45

For further details contact:

R.A. Lindsay
Fish and Wildlife Branch
Nelson, B.C.
(352-2211, local 484)

SUBJECT - Incubation of kokanee eggs in a new spawning channel.

ITEM - Eyed egg-to-fry survival rate.

The Hill Creek spawning channel was constructed in 1980/81 as a part of a fisheries compensation package to replace Upper Arrow Lake kokanee losses resulting from construction of the Revelstoke 1880 Dam. The channel (3.2 km by 6.1 m) is an extension of Hill Creek which discharges into Galena Bay, Upper Arrow Lake. Ultimate channel production requires 100,000 spawning adults (sex ratio 1:1) which is anticipated to create an adult return (catch plus escapement) of 500,000 based on a 40% egg-to-fry survival. Presently Hill Creek supports a native run of 10,000 adults. Supplemental egg plants are being conducted to increase production to the required 100,000 adults in the shortest time frame possible.

Approximately 2 million eyed kokanee eggs (Meadow Creek stock, Kootenay Lake) were planted in the spawning channel on October 26, 1981. There were 14,500 eggs/kg. Eggs were planted in 18 separate redds (110,000/redd) by pouring them down a 5 cm dia. plastic pipe buried in the redds. Pipes were pulled out of the redds after eggs were poured down them. Redds were approximately 0.6 m x 0.9 m x 0.46 m and were dug by hand. Gravel used was 0.6 - 5 cm dia. and rounded. This method of egg planting has been used with good success for some years in the Kootenays.

Fry emergence period was April 22 - June 14 with the peak occurring on May 25 (est. 256,520). Total estimated fry emergence was 1,203,806 resulting in an eyed egg-to-fry survival rate of 60%.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE April 27, 1983

MEMO NO. 62

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Alderdice - 45

For further details contact:

Judy Barnetson
Nanaimo (754-9971)

Bruce Hillaby
Nanaimo (753-1268)

Percy Walkus
Campbell River Radio
Oweekeno Nation
Dial: Vancouver Radio Operator
Ask for: N637574

SUBJECT - Free Floating Incubation and Hatching System (FIHS).

ITEM - A preliminary test of the FIHS as an incubation method in remote areas.

The effectiveness of FIHS was tested by The Oweekeno Nation Indian Band (Rivers Inlet B.C.), supported by the Salmonid Enhancement Job Creation Program 1982/83. This alternative incubation method was tested in a remote area where water quantity and quality were not limited, but cost and availability of materials, access and manpower were.

FIHS is a concept which assumes that given large quantities of water, such as a lake or back eddy of a large, slow-moving river, incubation of salmon eggs to the hatched stage can be successful without a traditional upwelling system. The volume of water surrounding the incubating eggs must be very large relative to the volume of eggs so that metabolic wastes can be diffused into the water column since there is no force of upwelling water.

Two "eyeing" incubators were constructed; one of 2" PVC piping and screen egg trays, the other of a 2 X 2 wooden frame and 1/4" plywood and screen egg trays. A single "hatching" incubator, constructed of a wood frame and Vexar screen, had two compartments each holding 2.5 cubic feet of 38mm Koch opaque flexi-rings (Bio-rings); this incubator carried eyed eggs in two screened compartments at the top which allowed the hatched alevins to swim down into the Bio-rings.

About 40,000 sockeye eggs were taken from Wannock River stocks from Nov. 1-5, 1982. As of Mar. 1, mortalities to the hatched stage barely exceeded 3%. Development to the fry stage appears to have coincided closely with the "wild" sockeye in the Wannock River.

The potential for this system is promising. A slightly more detailed report of FIHS will be forthcoming.

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IN memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 31, 1983

MEMO NO. 63

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 72
Pac. Biol. Stn. - 30

For further details contact:

S. MacLaurin
K. Hilland
Snootli Hatchery
Bella Coola
(982-2522)

SUBJECT - Fish Food

Item - Strategy for utilization of surplus fish food.

Fish feed is expensive and freight costs to isolated facilities are high. Snootli Hatchery successfully reduced the cost for feed by utilizing surplus feed from the previous rearing season.

The 1982 surplus feed was frozen at -15°C for 10 to 12 months. Analysis for rancidity, nutrient and vitamin content by West Vancouver Lab indicated that the feed was still usable. Furthermore, Dave Higgs of the West Vancouver Lab suggested that blending Vita-pak feed, which has a Vitamin C content double that in OMP II, with the surplus would ensure an adequate vitamin content. Consequently, the following feeding strategy was adopted: (1) 100% Vita-pak for initial feeding, (2) a blend of 1/3 surplus with 2/3 Vita-pak once fry were feeding well.

This strategy produced healthy 1.0 g chum fry in 6 weeks at 5.5°C. The food conversion ratio was 1:1.3 (growth:food). Average growth rate was 2%/day, slightly better than Stauffer's calculated maximum growth rate.

Cost savings for 1983 were significant:

New OMP II: (2,994 kg x $0.73/kg) + ($1,056 for freight) = $3,242

1/3 1982 OMP II with 2/3 Vita-pak: (1,990 kg x $0.84/kg) + ($704 for freight) = $2,376

$$\text{Savings} = \frac{3,242 - 2,376}{3,242} \times 100\% = 27\%$$

In this instance, storage and analysis costs were minimal and most of the above savings were realized. It should be noted that the quality of any feed stored for extended periods should be tested for rancidity, nutrient and vitamin content before utilization.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE July 7, 1983

MEMO NO. 64

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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K. Sandercock - 30
F.E.A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:

Dave Ewart
Bill McLean
Jim Van Tine
Quinsam Hatchery
Campbell River
(287-9564)

SUBJECT - Water Quality

Item - Zinc monitoring in the Campbell River system.

Zinc levels in the Campell River have shown an increasing trend since the early 1970's, with peak levels occurring in 1980 and 1981. Recognizing this as a serious threat to the fisheries in both the Campbell and its tributary (the Quinsam), Quinsam River Hatchery staff began monthly monitoring of these systems for metals and nutrients.

Sampling in 1982 showed a declining level of zinc in the Campbell River, and this trend is continuing on into 1983.

YEAR	MEAN EXTRACTABLE ZINC (ug/l)	PEAK EXTRACTABLE ZINC (ug/l)
1980	48	53
1981	49	56
1982	35	43

It is generally accepted that the major source of heavy metal contamination is related to the Westmin Resources Ltd. mine-mill operation at the head of the watershed (Buttle Lake) and, in particular, the leachate from waste rock piles. The actual relationship between the operation and downstream zinc levels is not fully understood. Since documentation of the metal problem in early 1980, the Company has initiated a major pollution abatement program, part of which is the collection and treatment of contaminated groundwater adjacent to the waste rock piles. While it is premature to predict the effect that the measures will have, it is hoped that water quality in the Campbell River System will improve. Continued sampling is required in order to assess Westmin's pollution abatement program.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE April 21, 1983

MEMO NO. 65

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
Pac. Biol. Stn. - 45

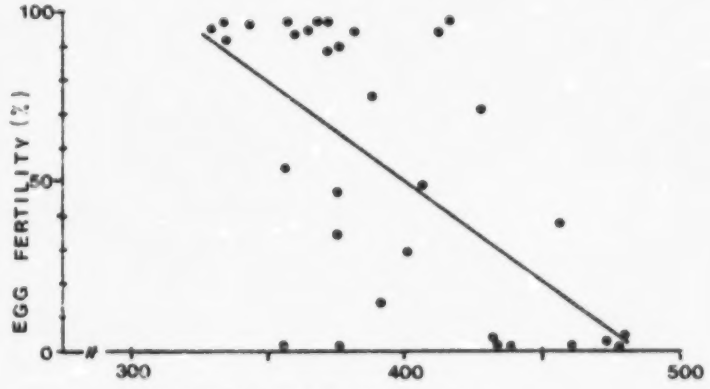
For further details contact:
Joachim Stoss
Ulf Fagerlund
West Vancouver Lab (926-4358)

SUBJECT - Egg and sperm fertility.

Item - Fertility problems associated with holding of adult chum salmon in saltwater.

Fertility problems have been reported frequently when salmon were kept until maturation in saltwater.

We investigated egg fertility from chum salmon matured in seawater (28‰) and found that fertility was only low in females which exhibited an abnormally high salt content (expressed as mOsm) in ovarian fluid. Fish with normal osmotic pressure (up to 350 mOsm) had high fertility:



In a subsequent study, we were able to demonstrate that fish can maintain a stable osmotic pressure in blood and ovarian fluid during maturation in saltwater, but that stress (chasing) causes an increase in the osmotic pressure, in other words - stress affects osmoregulation.

In sea water males, sperm usually is contaminated with ions secreted via the rectum when collecting sperm by stripping.

Conclusions

- good egg fertility can be expected when fish are not stressed.

- sperm should be collected by dissecting the testis.

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Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
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Pac. Biol. Stn. - 45

For further details contact:
I.I. Solar
Marine Resources Branch,
Province of B.C.
E.M. Donaldson
G.A. Hunter
Fisheries Research Branch,
Dept. of Fisheries and Oceans
West Vancouver Lab (926-4358)

SUBJECT - Sex control in salmonids

Item - Polyploidy induced by heat shock in rainbow trout.

The detrimental effects of sexual maturation on growth, survival and marketability of cultured fish may be prevented by rearing triploid fish. Viable triploid fish can be obtained by the application of thermal shocks to eggs soon after fertilization.

Rainbow trout eggs were treated for 10 min with heat shocks at temperatures of 24 to 30°C, 1 min and 40 min after fertilization. Heavy early mortalities occurred in the treated groups. However, the survival and general performance of these groups was similar to the controls after the first 60 days.

At 237 days post-hatch, the fish were sampled for ploidy determination. Blood samples taken by severing the caudal peduncle were analyzed by flow cytometry. This technique involves the "quantification" of the DNA content of thousands of individual erythrocyte nuclei using a fluorescent stain (DAPI) and UV excitation. The results are shown in Table 1.

Table 1

Group name*	Survival at 120 days %	No. fish assayed	Triploids %
24 - 1	19.4	11	18 (2)
24 - 40	53.7	10	30 (3)
26 - 1	21.1	12	83 (10)
26 - 40	19.3	10	90 (9)
28 - 1	13.0	11	82 (9)
28 - 40	18.8	12	100 (12)
30 - 1	22.0	9	67 (6)
Control - 1	71.8	11	0 (0)
Control - 2	57.9	9	11 (1)

* Group name indicates temperature (°C) and timing (min post-fertilization) heat shock applied.

Surviving fish in the groups containing a high percentage of triploids will be reared to observe further growth and sexual condition. Work will continue oriented to the improvement of survival and treatment effectiveness.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE June 1983

MEMO NO. 67

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 45

For further details contact:

Dorothee Kieser
Pacific Biological Station
756-7057

Eldon Stone
Capilano Hatchery
987-1411

SUBJECT - Disease Control

Item - Control of overt bacterial kidney disease in adult salmonids by erythromycin injection.

Rationale: Where a stock of adult salmonids has a history of bacterial kidney disease (BKD) and has experienced prespawning mortalities, it should be advantageous to control the disease by an injection of erythromycin.

The early-run coho at the Capilano hatchery return in June and are ready to spawn in October-November. During this holding time many contract BKD. This stock was used to test the efficacy of erythromycin injections against bacterial kidney disease.

Method: 400 early-run coho were injected at Capilano, 200 received 20 mg/kg erythromycin (Erythro-200 Abbot Laboratories, Ltd.) and 200 received an equivalent volume of sterile saline. Fish were anesthetized with a standard dose of 2 phenoxy-ethanol, injected into the dorsal sinus (anterior to the dorsal fin), clipped at the tail-fin to distinguish experimental groups and returned to the pond. Injections were carried out in early July 1983 and repeated in early August and late September.

Results: Fish fared well following all three injections. Losses due to handling and fungus were minimal. Pond mortalities and hatchery spawned carcasses were sampled for bacterial diseases with the following results:

	Saline injection	Erythromycin injection
BKD	21.7%	0.6%
Furunculosis	11%	13.8%

Out-Look: The erythromycin injections were successful in reducing the incidence of BKD. However, other bacterial diseases still presented a problem so that the prespawning mortality pattern between the two groups was similar. To combat BKD, Furunculosis and other bacterial diseases a single injection combining oxytetracycline and erythromycin is planned for the early run coho at Capilano during the 1983 season.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 27 July 1983

MEMO NO. 68

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 45

For further information contact:

D. F. Alderdice (756-7015)
J. O. T. Jensen (756-7013)
Pac. Biol. Stn., Nanaimo.

SUBJECT - Gas supersaturation in hatchery water supplies.

Item - Avoidance of problems in salmonid culture.

Total gas pressure (TGP) is emerging as a priority concern in the planning and conditioning of hatchery water supplies. A review and re-analysis of literature on TGP provides an incomplete yet basically clear understanding of the relation between TGP and gas bubble disease in salmonids. Much needs to be done to define the relation for different species, life stages and temperatures. However we are confident enough of the findings to offer the following initial recommendations. There is an exponential (log-log) relation between TGP (%) and effective time to 50% mortality (ET50), based largely on data for chinook and steelhead juveniles. ET50's range from ~17 days at a well-defined threshold of 102-103% TGP to ~0.1 days at 135% TGP based on water depths adjusted to 0 cm. Then as a rule of thumb each 1% TGP >102% (threshold) can be compensated by the hydrostatic pressure of 10 cm of water depth.

Example: 1. TGP in water supply-110%
2. Threshold level -102%
3. Difference 8%
4. 1%/10 cm = 8%/x cm
x = 80 cm
5. Compensation depth at threshold, for 110% TGP = 80 cm
6. Therefore to minimize TGP problems, hold fish somewhat deeper (i.e. 10%) than 80 cm.

Salmonids apparently do not detect gas overpressure but they do respond to its symptoms by diving to greater depths. Adults appear somewhat less sensitive to overpressure than juveniles. Juveniles appear to be most sensitive (10 cm chinook more sensitive than 5 cm), although this needs further confirmation. Hatcheries with a history of TGP problems should note the following. We suspect major tissue/organ damage may occur in alevins subject to gas overpressure when held in shallow containers (e.g. Heath trays), damage leading to later mortality in early juveniles. In further studies we will need to know altitude (above sea level) of hatcheries with suspected problems, barometric pressure when problem noted, water temperature, depth of container, and an estimate of fish holding depth. In intensive culture we recommend free CO_2 also be estimated in addition to ΔP or TGP.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE Aug. 3, 1983

MEMO NO. 69

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:

Brenda Donas
Inch Creek Hatchery
(826-0244)
Brian Mitchell
Chehalis Hatchery
(796-2281)
Dave Harding
Vancouver
(666-1847)

SUBJECT - Incubation of Salmonid Alevins

Item - Stoppage of flow in Heath Trays

In order to determine reaction time to flow stoppage in Heath trays at Inch Creek hatchery, pooled chum salmon eggs were volumed into each of 7 Heath trays (Feb 5/83; 533 ATU). Estimates were 7135 live and 1785 dead in each tray. The alevins incubated naturally on well water in a Heath stack until Mar 2/83 (638 ATU). Temperatures were declining gradually from 9°C on Feb 4 to 6.9°C on Mar 2, and flows were at usual operating levels.

On Mar 2/83, the flow was stopped for 60 min. Water temperature in the control tray increased from 6.9°C to 7.4°C, and dissolved oxygen decreased from 11.8 to 11.4 mg/l. Flow was restored and moralities were counted at 48 hrs., 120 hrs., and 57 days. The swimup fry appeared healthy and less than 1% had yolk sac problems.

A chi-squared analysis of mortality between trays was significant (x=27.28***, df=6); mortalities in the lower trays being greater. The difference, although statistically significant, is small; thus, we can infer that under similar conditions alevins (640 ATU) can be held in standing water in Heath trays up to an hour with only minor losses. The statistical test results can be taken as a warning that if flows are stopped for a longer time then mortalities become major.

	Start D.O.	Live Alevins	Total Mortality	Expected Mortality	x^2
Head Tank	11.8	-	-	-	-
Tray # 0	11.8	-	-	-	-
1	11.5	7164	100	116	2.21
2	11.3	7184	80	117	11.70
3	11.1	7130	123	116	0.42
4	10.8	7123	112	116	0.14
5	10.6	7113	114	116	0.03
6	10.6	7304	134	119	1.84
7	10.6	7296	155	119	10.89
					27.28***

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE August 4, 1983

MEMO NO. 70

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:
Gordon Bell 756-7065
John Blackburn 756-7010
Pac. Biol. Stn., Nanaimo

SUBJECT - Anesthetizing chinook smolts

Item - Use of MS-222 (TMS) and 2-phenoxyethanol (2 PE)

Bouck and Johnson (Trans. Amer. Fish. Soc. 108: 63, 1979) found TMS at 100 or 75 ppm caused 100% and 20% mortality, respectively, of coho smolts that had been transferred immediately to sea water (SW) following 6 and 8 min treatment, respectively. 100 ppm caused 12% mortality when fish were returned to fresh water (FW) for 4 days before being introduced to SW. No mortalities occurred over 10 days in the FW to SW or direct to SW groups when 50 ppm TMS or 2.5 ppm quinaldine was used.

Because certain hatchery managers were concerned about Bouck and Johnson's results as they might apply to their juvenile tagging programs, we tested TMS and 2 PE on chinook smolts using essentially the same protocols and procedures as these authors. In addition, we estimated adaptation to SW by measuring plasma sodium concentrations (Clarke and Blackburn, Fish. Mar. Serv. Tech. Rep. 705, 1977). In view of space limitations the results and recommendations are summarized below.

There were no mortalities over a 15-day observation period when fish were treated for 4 min with TMS at 75 or 100 ppm and returned to FW (14°C), or switched to SW (11°C, 29‰) 4 days post treatment but there was a 10% loss in FW using 2 PE at 0.5 mL/L (no losses using 0.25 mL 2 PE/L). There was about a 5-10% loss with either anesthetic when fish were immediately transferred to SW post treatment.

Based on efficacy, mortalities, and adaptation to SW we recommend the use of 75 ppm TMS for anesthetizing smolts to be returned to FW, or after a recovery period of at least 4 days, to be introduced to SW. If 2 PE is used, dosage should be $\leq$ 0.5 mL/L. Immediate introduction of anesthetized smolts to SW should be avoided if possible. Fish should not be fed for 72 h prior to anesthetization; exposure to anesthetic should be only of sufficient time to immobilize, and stressors such as handling, low pO_2, high temperatures and crowding should be minimized before, after and during treatment.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE August 26, 1983

MEMO NO. 71

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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K. Sandercock - 30
F. E. A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:
Frank Velsen
John Jensen
Pacific Biological Station
Nanaimo, B.C. V9R 5K6
756-7013

SUBJECT - Air bubbles in Heath trays.

Item - Sloping Heath stacks reduce air bubble formation under tray screens.

There has been some question of whether or not bubble formation under the screens of Heath trays may cause flow channeling in incubators, and "hot spots" during incubation.

Nine complete Heath stacks were operated, without eggs, in groups of 3: the 3 stacks of group 1 were placed level; those of group 2 had a forward tilt of 1 cm by placing the rear feet of the stack 1 cm higher than the front; those of group 3 had a 1 cm backward tilt. The stacks in each group operated at 3 temperatures of 6, 10 and 14°C. Bubble size (cm^2) was measured at 2 flow rates of 12 and 18 L/min, in 2 trays/stack, 1, 2, 4, 7 and 24 hr after starting the flows.

Tilt*		F	L	B
L/min	12	29**	51	14
	18	3	23	2

*F = forward, L = level, B = backward.
**Average bubble area over 24 hr (5 determinations at 1, 2, 4, 7, and 24 hr).

A flow of 18 L/min causes hydraulic problems with the backward tilted trays. In general the backward tilt (recommended by the manufacturer) provided a smaller problem with bubble formation than the forward tilt, and both performed better than stacks in the level position.

At PBS we have used the forward tilted trays for all experimental work at a flow of 12 L/min and a range of temperatures from 4 to 16°C. No detrimental bubble formation has been observed. The current data suggest that a 1 cm tilt (forward or backward) provides improved performance compared to level trays. A backward tilt may be of some advantage over forward-tilting trays, but we suspect the advantage is slight, if present.

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:

B. Donas
M. T. Foye
Inch Creek Hatchery
(826-0244)

SUBJECT - Fertilization of Chum Eggs

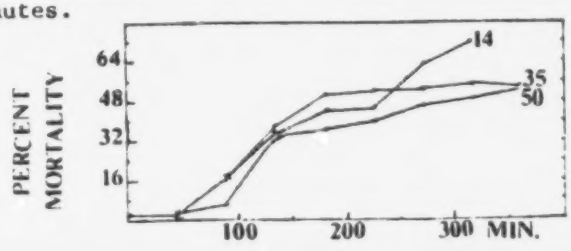
Item - Sperm viability vs time and air volume in a sealed container

The purpose of this experiment was to determine the amount of time that chum salmon sperm will remain viable at various air volume/total volume ratios by monitoring percent egg mortality per experimental lot.

Three trials were done at air volumes of 14, 35 and 50%. The eggs were stripped from each female and sperm was added. The mixture was pooled, mixed and then poured into clean 1 lb. coffee cans (diam. 9.4 cm, depth 13.4 cm) to the required depth, and the cans were capped. Every 45 minutes for 6 hours, one can of each air volume ratio was selected and water was added to initiate fertilization. The eggs in each can were then washed clean and poured into individual Heath trays for incubation.

A two-way analysis of variance on the data showed that both airspace and time affect mortality. Although the larger airspace does seem to reduce mortality, time is more significant. After 90 minutes, the mortality increases sharply. This could be due to fertilization occurring without the addition of water (consequently the eggs would become prone to mechanical shock) or to sperm losing its viability due to a lack of oxygen.

We observed that some of the alevins from the experimental lots had physical abnormalities. Therefore, due to the high mortalities as well as these abnormalities, this method of transporting gametes is not advantageous when transport time runs over 90 minutes.



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NI memo

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DATE September 27, 1983

MEMO NO. 73

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 45

For further details contact:

B. Donas
W.T. Foye
Inch Creek Hatchery
(826-0244)

SUBJECT - Juvenile Rearing

Item - Inflatable dividers for intermediate rearing troughs

Because Capilano-style starter troughs are in common use throughout most S.E.P. facilities, and a lot of problems have been encountered with movable screens that are not fry-proof, the inflatable divider was developed. The divider is constructed of perforated aluminum plate bordered by channeled aluminum. A bicycle inner tube (10 speed) is placed in the channel. Two sliding bolts, one on each side of the divider, allow secure holding to the trough. Holes (.63 cm) are drilled in the trough approximately .63 cm below the top lip. Any number of holes can be drilled along the length of the trough to allow for flexibility in the size or number of sections desired.

Once the divider has been bolted and the tube has been inflated, a fry-proof seal is achieved. Inflatable dividers are particularly useful in troughs where internal dimensions are variable. Current price is $110 each.

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DATE September 27, 1983

MEMO NO. 74

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Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 72
Pac. Biol. Stn. - 45

For further details contact:

B. Donas
W.T. Foye
Inch Creek Hatchery
(826-0244)

SUBJECT - Juvenile Rearing

Item - Insulated feed containers for intermediate rearing troughs

Vitamin C degradation in OMP feed will occur quite rapidly when temperatures exceed 20°C. It is therefore advantageous to use insulated containers at the raceways and troughs in order to keep food cool and thus retain the nutrient quality.

At Inch Creek, we use rectangular aluminum containers lined with 2.5 cm styrofoam insulation. The outside dimensions of the container are: length, 31 cm; width, 23 cm; and height, 24 cm. A soft plastic container (21 cm long, 14 cm wide, and 18 cm high) fits nicely into the insulated container. It holds 2.2 kg of feed. To make this insulated container, first cut a 9.5 cm hole in the bottom of the aluminum container. Then cut four styrofoam side panels and, finally, a bottom panel. Fit the side panels snugly into the aluminum container, and silicone the side panels together at the side seams, as well as around the bottom and at the top of the container so that no food can get in behind the panels.

Insert the bottom styrofoam panel, which is left free. For easy cleaning, the bottom styrofoam panel pops out (put hand through the hole in the bottom of the aluminum container and push stryofoam out), and the inside can easily be hosed out.

The containers are attached to the trough supports by two bolts. Access to the containers is good, and they are not in the way when cleaning or sampling. They have proved to be effective in keeping food cool for 6 to 7 hours in summer temperatures.

Fabrication costs were $25.00 for each aluminum container, and each plastic liner was approximately $4.50. The stryofoam insulation was added by staff on site.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 27 September 1988

MEMO NO. 75

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F. E. A. Wood - 80
Pac. Biol. Stn. - 38
West Van. Lab. - 7

SUBJECT - Chinook Adult Returns

Item - Returns from release of accelerated chinook juveniles of different sizes.

Growth of chinook juveniles was accelerated at temperatures of 10-14°C at Big Qualicum Hatchery over a three year period. Releases consisted of (1) 3 graded size groups on June 12, 1976; (2) 1 group of non-graded fish between April 20-26, 1977; and (3) 2 sets of 3 graded size groups between June 2-5, 1978.

Calculation of a line of regression describing the relationship between release size (based on 10 release groups years combined) and percent return indicates a strong positive, curvilinear relationship between the two factors ($y = -1.31 + 0.11X + 0.07X^2$, $r^2 = 0.88$). The table shows the predicted return rates for juveniles of different sizes. For example, the return from a release of 12 g juveniles (9.6%)is more than 5 times that from a release of 6 g juveniles (1.8%). The curve also suggests that release of even larger juveniles would yield even higher returns.

AV. JUV. weight (g)	% return
4	0.2
5	0.9
6	1.8
7	2.7
8	3.8
9	5.1
10	6.5
11	8.0
12	9.6

For further details contact:

H. T. Bilton
Pacific Biological Station
Nanaimo, B.C. V9R 5K6
756-7156

EMPHASIS:
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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE October 14, 1983

MEMO NO. 76

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

For further details contact:

Mike Wolfe
Robertson Creek Hatchery
(724-6521)

SUBJECT - Juvenile Rearing

Item - Baffles for Capilano troughs

A baffle for Capilano rearing troughs was designed and tested at Robertson Creek Hatchery over the 1982-83 rearing season. The baffles were found to be useful in moving sediment and feces along the bottom of the trough, in mixing the water column and in moving water from the stagnant area in the bottom of the trough. The baffles were cut from ≈ 10 mm (3/8 inch) plywood to the same shape as the trough, but with a 5 cm (2 inch) gap between the bottom of the baffle and the trough. The baffles were friction fit into place at 1/4, 1/2, and 3/4 of the length of the trough until the fry reached 1 g. Baffles were then placed at 1/3 and 2/3 of the length of the trough. The baffles eliminated the necessity of vacuuming the troughs, resulting in less time devoted to cleaning, less disturbance to fish, and less fouling of the water.

To study the flow characteristics of the troughs with and without baffles, we measured 1 litre of malachite dye into the top of the trough and recorded the clearing time. Without baffles, it took 7.5 minutes for the dye to reach the outlet and over 3 hours for the water to clear completely. The dye appeared to lay in a stagnant area at the bottom of the Capilano trough from the inlet to about 1/3 of the length. With baffles, it took 2.5 minutes for the dye to reach the outlet and less than 1 hour for the water to clear. No stagnant area was apparent.

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DATE October 14, 1983

MEMO NO. 77

CONTACTS

D. Alderdice, Pacific Biological Station
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A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

For further details contact:

Ed Britton
Robertson Creek Hatchery
(724-6521)

SUBJECT - Incubation of Alevins

Item - Chinook keeper channels

An experiment was designed to determine the best size range of gravel and the best level of coverage of the keeper channel floor when incubating chinook salmon. The three gravel size ranges selected were designated as: small 2.5 to 3.2 cm (1.0 to 1.25 in.), medium 3.8 to 5.1 cm (1.5 to 2.0 in.), and large 5.1 to 7.6 cm (2.0 to 3.0 in.). Coverage levels of 40% and 80% were selected and determined by covering a given area to a complete single layer of gravel (100%), weighing the sample, then covering the channel floor at 0.4 or 0.8 of this rate. Six combinations of three gravel sizes and two coverage levels resulted.

Flows were set at 273 lpm (60 Igpm). Channels were loaded at 10,000 eyed eggs (259 - 297 ATU) per square meter.

After hatch, migration and crowding at the upstream end occurred in all but the large gravel channel with 80% coverage. Alevins would crowd several layers deep at the upstream end of the channel, and in some cases there was insufficient flow to the bottom of the mass and suffocation resulted. The depth of the mass of alevins (in cm) was used as an indication of the degree of crowding.

Coverage	Depth of Alevins in Small Gravel	Depth of Alevins in Medium Gravel	Depth of Alevins in Large Gravel
40%	2.5-3.0 cm	1.5-2.0 cm	1.5-2.0 cm
80%	3.0-3.5 cm	1.0-1.5 cm	0 cm

These results seem to indicate that coverage level plays a primary role and gravel size a secondary role in the crowding phenomenon since the effect of larger gravel size is largely masked at the lower level of coverage.

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DATE October 14, 1983

MEMO NO. 78

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

For further details contact:

Glen Rasmussen
Puntledge Hatchery
(338-7444)

I.A. MacLean
Conuma Hatchery
(Vancouver Radio
N 710 215)

SUBJECT - Keeper Channel Incubation of Chum Salmon

Item - Effect of gravel size and alevin density on alevin migration

In an attempt to make keeper channels more efficient, a two factor experiment was set up at the Conuma River Hatchery. Six similar channels, 27 meters long and 1.9 m wide, were loaded with a single layer of round gravel. Three channels were given 1.91 cm - 3.81 cm (.75" - 1.5") gravel, and three were given 3.81 cm - 7.62 cm (1.5" - 3") gravel. The channels of each group were loaded with chum alevins at one of the three densities; 11,000/m^2, 14,000/m^2, or 16,000/m^2. A water flow of 360 l/min, a water depth of 12 cm, and a temperature 5°C - 6°C were maintained in each channel.

The upstream migration of alevins was determined by the number of days after 90% hatch to when the first alevins travelled the 10 meters to the top of the channel.

Alevin Density	Migration Time: 1.91 cm - 3.81 cm gravel	Migration Time: 3.81 cm - 7.62 cm gravel
11,000/m^2	12 days	50 days
14,000/m^2	0 days	19 days
16,000/m^2	0 days	0 days

The emerging fry from each of the two groups were measured for length and weight; they showed no significant difference in alevin condition. This appears to indicate that the use of the larger gravel allows a higher loading density with decreased migration as compared to the use of smaller gravel.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE October 14, 1983

MEMO NO. 79

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn - 45

For further details contact:

Chris Erickson
I.A. MacLean
Conuma River Hatchery
(Vancouver Radio
Operator N 710 215)

B. Anderson
Vancouver
(666-3958)

SUBJECT - Comparison of Substrate in an Upwelling Incubator

Item - Plastic Intalox saddles as a viable medium compared to a gravel substrate

Several incubators were designed (see table, Design Capacity) using either volume criteria (0.43 eggs/cm^3) or area criteria (16 eggs/cm^2). The incubators were constructed and inserted into Capilano troughs and approximately 50,000 chum eggs were placed on vexar screens suspended above the substrate of each incubator. The incubator flow was set at 30 l/min while flow in the trough was set at 205 l/min. Water temperature in the troughs and incubators was set at a constant 7°C, and oxygen readings remained above 10 ppm.

Substrate	Design Criteria	Design Capacity	% Early Migration
Gravel*	area	100,000	47
Intalox**	area	100,000	0
Intalox**	area	50,000	10
Intalox**	volume	50,000	0

Substrate description:
* 2.5 cm to 7.5 cm round river-type gravel (void volume = 31.7%)
** 2.5 cm plastic Intalox saddles (void volume=89.5%)

In the incubators, the peak fry emergence occurred between 950-1000 ATU's, and the fry were buttoned-up compared to keeper channels where the fry swim up at 850 ATU's with yolk sac showing. In the gravel incubator, a significant early migration occurred (47%), whereas the similarly designed incubator using Intalox saddle substrate had no early migration. This could indicate that the saddles have more usable space per unit than 2.5 cm - 7.5 cm size gravel does. In addition, there was an early migration (10%) from the incubator with the least amount of plastic substrate, probably due to the higher loading density. However, there was no early migration from the incubator using Intalox saddles loaded with eggs at the lighter density (i.e., volume).

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE October 14, 1983

MEMO NO. 80

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

For further details contact:

Ed Britton
Robertson Creek Hatchery
(724-6521)

SUBJECT - Incubation of Chinook Alevins

Item - Bulk box incubation system using a plastic substrate

An attempt was made to incubate chinook alevins in upwelling bulk boxes (79 X 62 X 55 cm) instead of the more traditional method of Heath tray or keeper channel incubation. The boxes were plumbed in a series of 4 or 5, with a horizontal screen secured 7 cm off the bottom. Box 2 in SERIES 1 had 50 mm plastic Intalox saddles filled to within 20 cm of the top of the box and the rest of the boxes had both 2.6 cm (1") and 3.8 cm (1.5") biorings. A 6 mm (0.25") vexar screen was placed over the plastic substrate, and flows were set at 55 lpm.

Newly hatched alevins from Heath trays were loaded into all boxes within 2.5 hrs. Densities were as follows, in thousands:

	Box 1	Box 2	Box 3	Box 4	Box 5
SERIES 1	140	180	140	100	180
SERIES 2	180	100	100	140	

Dissolved oxygen (measured by the Winkler method) 45 min. after loading was 3.1 mg/l and 8.2 mg/l at the outflows of series 1 and 2, respectively. At the inflows, DO was 11.3 mg/l (5°C). Flows were immediately increased to 100 lpm, and lights were turned off and the boxes were covered. About 20% of the alevins in box 5, series 1, were lost due to low oxygen and stress during loading. After 8 hours the DO was 8 mg/l and 9.5 mg/l at the outflows of series 1 and 2, respectively.

Mortality occurred in four areas. There was general stress and inadequate flows at loading. In addition, soon after the alevins were loaded, suffocation occurred due to flow problems. (Alevins swam to the bottom of the boxes, packing tightly. Stagnant water or "hot spots" developed, and large numbers of alevins suffocated. Alevins also passed through and around the .4 cm bottom screen, further restricting the flow. Most alevins appear to have died after passing through the screen or from packing tightly at the bottom of the box.) Finally, mortality also occurred due to the development of toxic byproducts as the dead alevins decomposed. The mortality at ponding was estimated at 50%.

Survivals can be improved by increasing flows, loading eyed eggs rather than alevins (to reduce stress caused during loading), and by closely monitoring oxygen levels in the outflow and in the substrate. Because the water was particularly silty during the winter months and plugged the bottom screens in about 2 weeks, only filtered water should be used. We also believe that bottom crowding may be reduced by using horizontal screens placed at 1/4 and 3/4 of the depth of the box and recommend that smaller screens (.3 cm or less) be used and secured to restrict alevin movements and prevent bunching.

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INFO memo

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DATE October 14, 1983

MEMO NO. 81

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

For further details contact:

J. Don Buxton, SEO
Chilliwack River Hatchery
(604)858-7227

SUBJECT - Artificial Substrate for Instream Adult Fences

Item - A method to stabilize stream beds to facilitate installation of temporary adult fences

It is often necessary to install temporary fences in wild streams in order to count or capture adult salmon. The best location logistically often does not have suitable substrate to prevent undermining. A method of stabilizing the stream bottom where the fence will rest has been used successfully on the Chilliwack River system for seven years.

The method involves laying a single layer of 6 mm plastic sheet, 6.1 m (20 feet) in width, across the stream bed. A layer of 8 gauge vinyl-coated chain-link fencing is laid on the plastic and held in place by sand bags and reinforcing rods driven into the stream bed.

Method of Installation

1. If possible use a bulldozer to level stream bottom to even out flow and depth.
2. Place plastic sheet in 15.2 to 22.9 m (50 to 75 ft) sections, holding leading edge down with sand bags; overlap each section at least 1.2 m (4 feet).
3. Unroll 3 m (10 foot) wide chain-link fencing over downstream half of plastic first, then unroll next section over upstream half of plastic, overlapping the lower strip by about 0.3 m (1 foot).
4. Lay 3 rows of sand bags over leading edge of chain-link/plastic sheet substrate. Drive 1.5 m (5 foot) long re-bar through fencing and plastic into the bottom at leading edge about 2.4 m (8 feet) apart across stream.
5. Randomly place sand bags over entire covering until bulging and lifting is eliminated.
6. Place fence in middle of covering.

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INFO memo

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DATE October 31, 1983

MEMO NO. 82

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
Pac. Biol. Stn. - 45

SUBJECT - Adult returns from release of Steelhead juveniles

Item - Time and size at release.

In the spring of 1980, four releases (April 6, April 26, May 16, and June 5) of juvenile steelhead, each composed of three graded size groups, were released from the Rosewall Creek hatchery, representing a combined total of 76,687 marked and tagged fish. Adults returning from these releases were recovered at Rosewall in 1982 and 1983. The total returns of adults to the weir only were all very low. Despite the overall low returns, differences apparently associated with the effects of size and time of release were indicated (see table below); little can be said regarding effects of parental age.

Ocean-age parents	Release date	$\bar{x}$ Juvenile weight (g)	Percent returned as 2-ocean	3-ocean	2- plus 3-ocean
2 X 2	April 6	10.6	0.0	0.0	0.0
		20.7	0.0	0.0	0.0
		36.1	0.0	0.0	0.0
2 X 2	April 26	13.7	0.0	0.0	0.0
		28.5	0.0	0.0	0.0
		47.0	0.06	0.0	0.06
3 X 3	April 26	18.0	0.0	0.0	0.0
		36.2	0.02	0.07	0.09
		50.7	0.17	0.14	0.31
2 X 2	May 16	17.6	0.0	0.0	0.0
		36.0	0.0	0.07	0.07
		55.3	0.14	0.12	0.26
2 X 2	June 5	29.8	0.0	0.0	0.0
		42.9	0.0	0.0	0.0
		59.2	0.0	0.07	0.07

The highest returns (0.31%) resulted from 50.7-g juveniles (3 X 3 cross) released on April 26, closely followed by the return of 0.26% from 55.3-g juveniles released on May 16. There were no returns from the April 6 release, and a very low return of 0.07% from June 5 release. These results suggest that maximum returns will be achieved from release of 50-g juveniles in late April-early May.

For further details contact:
H. T. Bilton
R. B. Morley
Pacific Biological Station
Nanaimo, B.C. V9R 5K6
756-7156 or 756-7141

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INFO memo

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DATE 25 November 1983

MEMO NO. 83

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 25
A. Lill - 3
D. Narver - 17
K. Sandercock - 30
F.E.A. Wood - 72
West Van. Lab. - 6
Pac. Biol. Stn. - 30

For further details contact:
Peter Rombough
Pacific Biological Station
Nanaimo, B.C. V9R 5K6
756-7019

SUBJECT - Ponding Times for Chinook

Item - The effect of initial egg weight on the optimum time to initiate feeding of chinook salmon (Oncorhynchus tshawytscha)

Eggs of chinook salmon Oncorhynchus tshawytscha were segregated into eight size groups and incubated at 5, 7.5, 10, and 12.5°C. Mean initial egg weights for the various groups ranged between 163 and 437 mg. The length of time required to reach maximum alevin wet weight (MAWW) varied significantly ($p<0.01$) with temperature and initial egg weight. A good prediction of time to MAWW was given by the equation

$$\ln d = 5.88 - 0.152T + 0.000513W \quad (r = 0.9920;\ n = 21)$$

where d is days postfertilization to MAWW, T is mean incubation temperature (°C) and W is initial egg weight (mg). Optimum ponding times are closely associated with the attainment of MAWW and can be estimated using this equation. The best value to use for initial egg weight depends on the degree of size variability in the group of eggs under consideration. If variability is low then mean initial weight can be used. However, if variability is high the lower 95% confidence limit for initial egg weight should be used. A value of 200 mg should be used if initial egg weight is unknown.

Data relating temperature and chinook ponding time were collected from 17 hatcheries throughout B.C. The equation

$$\ln d = 5.99 - 0.150T \quad (r = 0.9864;\ n = 85)$$

where d is days postfertilization to ponding and T is mean incubation temperature (°C) provided the best fit to the data. Actual mean ponding times were not significantly different from times to MAWW predicted for 200 mg eggs.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 1 December 1983

MEMO NO. 84

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:
H. T. Bilton/R. B. Morley
Pacific Biological Station
Nanaimo, B.C. V9R 5K6
756-7156 or 756-7141

SUBJECT - Adult Returns From Release of Steelhead Juveniles

Item - Effect of parental ocean age and juvenile size at release on survival and age of progeny at maturity.

A current study at Rosewall Creek, V.I., B.C., bears on the extent to which age at maturity in steelhead is genetically and/or environmentally controlled. On April 30, 1979, 80,231 nose-tagged juveniles were released from Rosewall Creek hatchery — the progeny of 2- or 3-ocean parents, each type graded to small, medium and large size categories. In 1981 and 1982, progeny returning as 2- or 3-ocean adults were recovered from Rosewall Creek.

1. Total returns - Total returns (all 2- and 3-ocean adults) showed a significant positive correlation ($r^2 = 0.88$) between % return and juvenile weight, (increased returns with increasing juvenile size). This relation was statistically the same for progeny of both parental types, suggesting zero returns from juveniles 23 g or less.

2. Returns as 2- or 3-ocean adults - Percent return as 2-ocean adults vs weight of juveniles of 2- or 3-ocean parentage gave results very similar to those observed for total returns. Again, there was a highly significant positive correlation ($r^2 = 0.92$) for the progeny of combined parental types, with no significant differences between the relationships for progeny of each type considered separately.

Returns as 3-ocean adults were very low (44 of 236 recovered) making it difficult to draw firm conclusions. Returns as 3-ocean adults vs weight of juveniles showed no significant correlations for progeny of 2- and 3-ocean parentage (considered separately or combined). However, weak positive correlations were suggested in each case.

3. Conclusions - Increased total returns with increasing juvenile size appears attributable almost entirely to increased returns of 2-ocean adults while returns of 3-ocean fish varied randomly, unrelated to juvenile size. While no significant effect of either parental age or juvenile size on age at return could be demonstrated from the data, there was a strong suggestion that age structure (and magnitude) of total returns changed with juvenile size. Higher representation of 3-ocean fish (as a proportion of total returns, but not in absolute numbers) was indicated by a reduction of 2-ocean fish (and total returns) from release of smaller juveniles. Conversely, larger juveniles increased returns of 2-ocean fish (and total returns) with no change in representation of threes, resulting in a decreased proportion of threes in the total returns.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE 28 November 1983

MEMO NO. 85

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
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A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact
Dale Larson
Fraser Valley Hatchery
853-8394

SUBJECT - Transport and Release of Juveniles

Item - A new mechanism designed for helicopter fry releases.

In an attempt to create a safe, economical and efficient method of salmonid fry transport and release, Vancouver Island Helicopters Ltd. in conjunction with fish culturists in the Fish & Wildlife Branch, Ministry of Environment, designed and built a device for fry release from a helicopter. This machine was used successfully by the Provincial Fish Culture Section on several steelhead fry release operations during 1983.

The fry release device is designed to be suspended from the Bell Long Ranger helicopter on a 30-meter long line. It consists of ten 30-litre containers filled to 22 L, each separately hinged to the machine frame and covered by a flip-up plexiglass lid to prevent fish from escaping during flight. Each container is individually supplied with oxygen through perforated plastic tubing from an oxygen bottle clamped to the frame. In addition, each container may be released separately through an electrical solenoid that is operated by a hand held control box from inside the helicopter.

Fish of 1-5 gram have been loaded as heavily as 400 grams per litre (4 lb/gallon) for over thirty minutes with no overt signs of stress occurring. Some advantages realized through the use of this device are:

1. Greater safety to the people involved because the helicopter is able to stay above the forest canopy on most streams due to the long line used.
2. Only one person in addition to the pilot is required in the helicopter.
3. Since the helicopter does not have to constantly lower and lift to avoid trees the fish release at each site is more efficient than a previous method using a 10-meter long hose with all fish carried within the helicopter.
4. A larger payload and more groups can be carried at one time.

In summary, this fry release mechanism has proven to be safe, useful and economical in the release of salmonid fry.

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NI memo

For internal, informal, rapid exchange of information between data producers & users.

DATE Dec. 19, 1983

MEMO NO. 86

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details, documentation or copies of the programs contact:
Anne Kling
5th Floor
1090 West Pender St.
Vancouver, B.C.
V6E 2P1
666-6126

SUBJECT - Fishculture Information System for Hatcheries (FISH)

Item - FISH system requirements, operating basis and data management system

The Fishculture Information System for Hatcheries (FISH), a system developed for on-site facility use, consists of a FISH data management system (DMS) and FISH utility programs. The requirements and operating basis of the overall system plus a description of the FISH DMS are described in this memo. The FISH utility programs are described in Info Memo #87.

The FISH DMS stores data on eggs, juveniles and adults (e.g., inventory, bio-data, recovery). On request it will generate reports summarizing the data. For example, Report Adult Data will search through all entered adult data and generate a report showing length and weight means and standard deviations for sampled fish as grouped by C/T. The report can also be divided by age group, recovery location, sex, finclip and date.

FISH requires an APPLE II+ or IIe with a minimum of 64K of random access memory, a video monitor, two disc drives, and a printer capable of printing 233 characters per line. FISH uses an Orange Micro Grappler printer interface card or an Interactive Structures Rsaso card. FISH also requires a VisiCorp VisiCalc disc, as the incubation and juvenile inventory sections use VisiCalc tables.

FISH is contained on three computer discs; a FISH disc, a FISH Utilities disc and a VisiCalc Master Formats disc. Both FISH and FISH Utilities operate from central Menu programs which present the user with the titles of the programs available for use. The user is prompted to select a number indicating the program he wishes to use. Once an acceptable number has been entered and verified, the computer presents the appropriate program and prompts the user for inputs. Relatively inexperienced users can obtain the results desired by following the accompanying manuals and monitor prompts.

Advantages to FISH are many. Because data are standardized among facilities, assessment is less complicated and faster. Data are quickly available to all levels of management allowing prompt analysis and control. The time lapse between data collection and analysis is reduced. Fishculture models are easily accessible, allowing facility managers to refine daily activity and allow projections of operational requirements. The programs contained in the FISH DMS are:

Menu - summons other programs, which when finished return the user to the Menu
Create Brood Disc - formats a disc for juvenile and incubation data storage
Enter Incubation Data - incubation data input for inventory and comments (inventory on VisiCalc)
Enter Juvenile Data - juvenile data input for inventory, comments, lengths and weights, and brood summaries (inventory on VisiCalc)
Retrieve Incub/Juv Data - incubation and juvenile data retrieval
Create Adult Disc - formats a disc for adult data storage
Enter Adult Data - adult data input
Update Adult Data - update adult C/T and scale data to include ages
Report Adult Data - adult data retrieval and report generation
Edit Adult Data - correction of stored adult data
Fish Plot - graphics of length and weight data for juveniles and adults
Mailbag - saves and retrieves comments and messages from FISH and data discs

Complete documentation is available and will be published in the near future.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE Dec. 19, 1983

MEMO NO. 87

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details, documentation or copies of the programs contact:
Anne Kling
5th Floor
1090 West Pender St.
Vancouver, B.C.
V6E 2P1
666-6126

SUBJECT - Fishculture Information System for Hatcheries (FISH)

Item - Utility programs

The Fishculture Information System for Hatcheries (FISH) is a two part system developed for on-site facility use. The FISH system requirements, operating basis, and data management system were explained in Info Memo #86. The utility programs are explained here.

The utility programs fall into four groups; statistical design, bio-engineering design, biological modelling and fishculture application (see Info Memo #22). For example, the program Fish Health calculates the required dosage for prophylactic treatments in fish ponds (see Special Publication #68, Computer Management of Fish Health Problems in Hatcheries by G. Hoskins, C. West and A. Kling). It provides suggested treatments and application methods for prevention or control of twenty-four fish diseases common to B.C. waters at four life stages of fish. By eliminating human error from intermediate calculations and unit conversions, Fish Health reduces the potential for fish loss.

Like the FISH data management system, FISH Utilities operate from a central Menu program which presents the user with the titles of the programs available for use. The FISH utility programs are:

Aeration Constant - calculates aeration coefficients of aeration substrates
Aeration Model - simulates aeration towers for modelling
Bio-Load - calculates loading rates and required pond flow
Case Reporter - asks questions necessary for fish disease diagnosis and generates reports
Fish Health - calculates prophylactic treatment dosages (see above)
Flush Treatment - a condensed version of Fish Health
Growth Model - simulates fish growth in a rearing pond, estimating fish size, growth rate, feed rate and conversion rate
Heath Stack - calculates oxygen drop through a stack of heath trays prior to ponding
Histogram - producers frequency histograms from entered data
Load Rate - calculates load rate, metabolic rate and required pond flow
Mean & Sd - calculates mean, standard deviation and coefficient of variation for one variable
Pond Inventory - calculates number of fish to mark in a pond, number to sample, error rate of estimate, or Petersen population estimate
Pond Oxygen Level - calculates metabolic rate, average dissolved oxygen levels, minimum allowable oxygen, and maximum food ration
Single Mark Group - mark recovery formulae for single release groups
Total Gas Pressure - calculates oxygen, nitrogen and total gas pressures of water supplies, allowing heating, cooling and mixing with another source
Two Mark Group - Equal - mark recovery formulae for two release groups of equal size
Two Mark Group - Unequal - mark recovery formulae for two release groups of unequal size

Complete documentation is available and will be published in the near future.

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D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 6
Pac. Biol. Stn. - 38

For further details contact:

David Southgate
or
Ron Kadowaki
(604) 627-8730

SUBJECT - Mortalities Due To Coded-Wire Tagging (CWT) Procedure

Item - Coded-wire tagging of sockeye smolts

As part of the International Tagging Program, 138,531 full length coded-wire tags (CWT) were applied to sockeye smolts at the outlet of Babine Lake, between May 10 and June 3rd, 1983. Standard CWT methods were used throughout the program (MS222 was the anesthetic used). In addition, experiments were conducted to determine at what stage of tagging mortalities occurred.

The smolt program is divided by time into an early and late run; 38,563 tags were applied to the early run and 99,968 to the late run. Overall tag retention was 97.8 percent; 94.5 percent in the early run and 98.6% in the late run. Average daily mortality was 1.29 percent (0.2% to 3.6%).

Average daily water temperature over the course of the program was 10.2°C (6°C to 12°C).

The results of the mortality experiment based on 6 replicates are as follows:

	Treatment	Mortality - Range (%)
Test 1)	Anesthetic, malachite	3.3 - 1-9
Test 2)	Anesthetic, adipose clip, malachite	3.4 - 0-9
Test 3)	Anesthetic, adipose clip, tagged, malachite	3.3 - 0-6

A fourth pen, containing a control group, had a mortality of 13%, but since these fish were not graded, a lot of the mortality could be attributed to small fish size.

Since the juvenile sockeye were in the "smolting" stage there was some concern, before the program, over scale loss due to handling. However, we experienced very little overall mortality, and the mortality that did occur was probably related more to fish size than to scale loss.

Length data for 1983 are currently being compiled, but it is known that Babine sockeye smolts generally average between 6 and 8 cm. in length.

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DATE Jan. 17, 1984

MEMO NO. 89

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

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D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 6
Pac. Biol. Stn. - 38

For further details contact:
G.A. Hunter
E.M. Donaldson
West Vancouver Laboratory
Fisheries Research Branch
926-4358

SUBJECT: Sex control: chinook salmon.

Item: A technique for increasing the production of female chinook salmon

Studies at the West Vancouver Laboratory have resulted in the development of a technique for the production of all-female chinook salmon. The technique is conducted in 2 stages, each requiring a single generation for completion.

First stage - In the first stage chinook alevins are administered an androgen in the rearing water. The fry are then fed a diet containing the steroid for 3-9 wks. This treatment results in masculinization of the group. The milt from genetic males in the group will produce offspring in a normal 1:1 male-female ratio. The milt from the genetic females will produce 100% female groups. Therefore, the use of a random mixture of both genetic males and females will result in the production of approximately 75% female offspring. A group of 200000 chinook treated in the above manner were released from the Capilano in 1983. These fish have been marked to permit their selective use as broodstock males.

Second stage - Where facilities permit the holding of these fish as broodstock it is possible to identify the progeny of the sex-reversed genetic females, which then may be masculinized and reared to maturity. The milt from all of the fish in these groups will produce 100% female offspring. Milt from such a group (Capilano stock) has been used to fertilize 100000 ova at the Capilano, and over 200000 ova at 3 commercial aquaculture facilities. Survival to the eyed stage at the Capilano exceeded 91%. The all-female group at the Capilano, scheduled for release in 1984 will be fin clipped and nose tagged to monitor ocean survival.

Applications - This technique provides a means of increasing the proportion of females in a stock. Potential benefits accruing from implementation of the technique include 1) a rapid enhancement of hatchery stocks through an increased egg take, 2) an increase in the age at maturity, 3) a reduction in jack production and 4) an increase in roe production. In commercial aquaculture it provides a cost-effective method for holding broodstock and permits the rearing of larger fish.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE January 24, 1984

MEMO NO. 90

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 81
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:

Charles Lam
SEP Operations,
1090 W. Pender St.
Vancouver, B.C. V6E 2P1
666-3663

SUBJECT - Egg Fertility

Item - Does uncoagulated blood effect egg fertility?

This question has often been asked by hatchery staff. McNeil and Bailey (1975) in their Salmon Rancher's Manual and Piper et.al. (1982) in their Fish Hatchery Management book advised against blood contamination of eggs. Yet, neither publication listed any supportive evidence. Hatchery staff have been painstakingly avoiding blood contamination, even to the extent of discarding blood contaminated eggs. In August, 1983 we conducted an experiment (2 trials) at Snootli Creek Hatchery with chum salmon eggs to investigate this problem.

We compared 6 levels of blood contamination expressed as % blood volume/egg volume; 0, 1, 2, and 3% in Trial I, and 0, 6, and 12% in Trial II. In each trial, we pooled eggs from 3 ripe females. Blood was collected from 2 freshly killed fish. To each treatment, we added the appropriate quantity of blood and mixed. Time from egg take to fertilization was 2 and 3 hours in Trials I and II respectively. The pooled milt volume used was about 1.5 ml (0.75% of egg volume). The milt/egg ratio in this study was about the same as that used in our hatcheries (e.g., a minimum of 20 ml milt for 2400 ml eggs). Three 30 ml subsamples of fertilized eggs from each treatment were incubated in Heath tray compartments. Egg fertility was evaluated at the eyed stage. Results:

	TRIAL I				TRIAL II		
Amount of blood (%)	0	1	2	3	0	6	12
Mean egg fertility (%) (± SD)	97.8 (±0.1)	100.0 (±0.0)	99.9 (±0.5)	97.7 (±2.1)	99.1 (±0.9)	98.6 (±0.0)	99.1 (±1.0)

Therefore, blood contamination up to 12% of egg volume and a contact time of up to 3 hours does not reduce egg fertility. The low milt/egg ratio and the high blood/egg ratio tested in this study suggest that in normal hatchery production conditions, even if blood coagulation binds up certain sperm cells, the amount of sperm cells that remain are capable of fertilizing all of the eggs.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE February 14, 1984

MEMO NO. 91

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:

H. Galesloot,
Eagle Hatchery
(836-4281)

J. VanTine,
Quinsam Hatchery
(287- 9564)

SUBJECT - Heating Water For Incubation

Item - A source of free heat for the development of eggs and alevins

A simple heat exchange system utilizing compressor water from the walk-in freezer was tested to advance the development of eggs and alevins at the Quinsam River Hatchery. This water cannot be used directly for incubation due to its high copper content and its variable, and occasionally high, temperatures.

"Waste" water was piped from the freezer compressor to a 70 litre plastic pail situated in the upper half of a Heath stack in the incubation room. One hundred feet of coiled 1.25 cm ($^1/_2$ inch) soft aluminum was placed inside the pail.

Hatchery water from Cold Creek, ranging from 8.9 to 10° C, was fed into the coils at a rate of 7.0 lpm. Compressor water in the pail ranged from 20 to 30° C. There was a 4° C temperature increase, on average, of the water leaving the coils; this heated water was then fed into the Heath trays below.

This system, which is suitable for groups of 50,000 to 70,000 eggs, has been successful in advancing the development of steelhead eggs and alevins.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE March 14, 1984

MEMO NO. 92

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details, contact:

B.W. Ludwig
Ministry of Environment
Fish and Wildlife Branch
218-780 Blanshard Street
Victoria, B.C.
V8V 1X5
Telephone: 387-1961

SUBJECT - Aeration of hatchery water supplies using small diameter packed columns.

Item - Preliminary testing—Influence of water flow and Flexiring diameter on column performance.

Many of our Provincial fish culture facilities use well water as the main water supply. Typically well water is low in dissolved oxygen and high in nitrogen and therefore requires aeration. We have relied on wood slat towers to handle the aeration needs at most of our facilities. Recently, McLean and Boreham (1980) outlined a design procedure for large diameter packed columns (25-30 cm) that could handle water flows between 260 and 675 ℓ/min. There have been several instances where we have needed to aerate a small quantity of water within the confines of an existing building where head is limited. In response to this, a 10 cm diameter (9.5 cm ID) packed column was tested at Kootenay Trout Hatchery using heated water (15° C). The column was constructed of PVC pipe and consisted of three or four 30.5 cm long segments, with a 5 cm gap between each segment.

A four segment column was used to investigate the influence of water flow and ring diameter on column performance. The results are summarized below. For both the 1.6 cm and 3.8 cm diameter Flexirings (biorings), the column performance was reduced as water flow increased. The large diameter rings consistently outperformed the small rings, even at low flows.

In a separate test, a three segment column, packed with 3.8 cm diameter Flexirings, and operated at 50 ℓ/min (15° C), reduced incoming oxygen (110%) and nitrogen (113.9%) levels to 102.3 and 103.8% respectively. For column design purposes, the aeration coefficients for oxygen and nitrogen were 0.4852 and 0.4296, respectively.

The small diameter column proved to be an efficient aerator and will be particularly useful in low flow, low head situations.

Influence of water flow and Flexiring diameter on column performance

Flexiring diameter (CM)			Water flow (ℓ/min)					
			11	16	30	42	50	86
1.6	Nitrogen (%)	Inflow	112.4	116.0	113.3	113.5	-	-
		Outflow	102.6	104.0	105.4	105.8	-	-
	Gross aeration coefficient		1.56	1.39	0.90	0.84	-	-
3.8	Nitrogen (%)	Inflow	-	-	117.3	-	118.0	115.0
		Outflow	-	-	101.9	-	102.1	103.2
	Gross aeration coefficient		-	-	2.21	-	2.15	1.54

Note: 1) The gross aeration coefficient is a measure of the efficiency of the column.
2) A single measurement of total gas pressure (Novatech tensionometer) and oxygen (Winkler) was made at each flow.

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INFO memo

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DATE 15 March 1984

MEMO NO. 93

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
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D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:
U.H.M. Fagerlund
J.R. McBride
West Vancouver Laboratory
Fisheries Research Branch
926-4358

E.T. Stone
Capilano Hatchery
Enhancement Operations
987-1411

SUBJECT - Coho density studies at Capilano hatchery.

Item - Importance of density at the fry stage.

Studies designed to test the effect of ponding density of coho on adult return rates have been conducted at Capilano hatchery with juveniles released in 1977, 1979 and 1980 (Sandercock and Stone, pers. comm. 1980, Fagerlund et al., Can. Tech. Rep. Fish. Aquat. Sci. No. 1229, 1983). The rates of adult returns (expanded total fishery and hatchery returns) from all releases were inversely proportional to loading density (see Table). However, this effect was very weak for the 1980 release compared to that for the two other releases. A notable difference in rearing conditions was that fish in the 1977 and 1978 studies were raised at the experimental densities (fish/vol) for 12 months, commencing from the initial ponding when fish weighed about 3 g, while in the 1980 study different ponding densities were maintained for only 5 months from January, when fish weighed about 11 g.

High ponding density during the final stages of pond rearing is known to affect the quality of smolts, since a large biomass may result in a) reduced O_2 levels and increased excretory product load and b) social stress. However, even during the early rearing period, when biomass is small, high ponding density may interfere with the fishes' spatial requirements. This could be expected since the level of domestication of hatchery stocks is low and density in streams of wild stocks is much lower than that maintained in hatcheries.

The importance of density during the early life stage of coho suggested by these studies is corroborated by other research with coho in Oregon and steelhead in B.C. The accummulated evidence suggests that attention should be given to rearing practices during the fry stage. Density during the initial rearing in troughs as practised in some B.C. hatcheries may also influence performance.

Table - Percent increase in adult returns when ponding density was decreased from 1200 to 600 fish/m^3 calculated from regression equations.

Release year	1977	1979	1980
% increase	76.0	42.9	9.2

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DATE 15 March 1984

MEMO NO. 94

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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Pac. Biol. Stn. - 38

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J.R. McBride
West Vancouver Laboratory
Fisheries Research Branch
926-4358

E.T. Stone
Capilano Hatchery
Enhancement Operations
987-1411

SUBJECT - Coho density studies at Capilano Hatchery.

Item - Effect of social interaction in ponds.

Coho fingerlings were raised at Capilano Hatchery from January to release in June 1980 in two sets of ponds, each made up of 3 densities. In one set fish were tagged with magnetic nose tags identifying equal-numbered sub-populations of small, medium and large size fish (Can. Tech. Rep. Fish. Aquat. Sci. No. 1229, 1983).

The effect of ponding density on adult returns in this study (see below) was small in contrast to previous studies. A reason for this was suggested in Info Memo # 93 . However, at each density the return rate (expanded fishery and hatchery total) of adults originating from small size smolts (1/3 of the population) was much lower than that from medium and large size smolts.

Physiological differences between the sub-populations, such as lipid content, suggest that a hierarchical relationship between fish of different sizes may have been established. Such social interaction in animal populations are known to cause stress in sub-dominant individuals resulting in physical deterioration and lower survival.

We do not have at this point the information necessary to determine whether the origin of differences between sub-populations are genotypic or phenotypic. The latter could result from pooling in one pond (or trough) fry hatched at different times and therefore of different sizes. In either case the effect of social interaction may be minimized by avoiding the pooling of fry hatched at different times or by increasing size of late hatching fry in separate troughs before combining them with earlier hatched fry.

Table - Adult returns as % of released smolts.

	No. of fish/Burrows pond (No./m^3)					
	49,410 (586)		70,313 (835)		78,195 (928)	
Sub-population by size	% adults	Smolt size (g)	% adults	Smolt size (g)	% adults	Smolt size (g)
Small	13.4	10.5	12.0	11.1	13.1	9.4
Medium	21.1	13.9	19.5	13.9	21.7	12.5
Large	23.4	18.0	23.2	17.2	18.5	16.2

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For internal,
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DATE 19 March 1984

MEMO NO. 95

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 756-7015

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
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F.E.A. Wood - 80
West Van. Lab. - 6
Pac. Biol. Stn. - 38

FOR FURTHER DETAILS CONTACT

G. Hoskins (Pac.Biol.Stn.)
H. Genoe (Puntledge Hatchery)
G. Bell (Pac.Biol.Stn.)

SUBJECT: Fish Health

Item: Proliferative kidney disease (PKD)

PKD, a condition thought to be caused by a protozoan parasite, was found associated with chronic mortalities of steelhead in late summer and early autumn of 1983 at the Puntledge River Salmon Hatchery. The outbreak, complicated by concurrent furunculosis, subsided and PKD has not been evident since. This is the first known occurrence of this disease in Canada and the third locality in which PKD has been reported in North America. The first modern description of PKD resulted from outbreaks in Ireland and Scotland (J. Fish. Dis. 1:91, 1978). Since then it has been found to be widespread in Europe, possibly because of movement of infected fish, and/or possibly because of increased recognition of this difficult to diagnose disease. Lack of any but local introductions of fish at the Puntledge River and the occurrence of the disease in Hatchery coho in 1982 (then unrecognized), lead us to believe that the pathogen exists naturally in the River. There is no known treatment for PKD, and eradication by destruction of the affected stock was considered futile because of the likelihood of re-introduction of the PKD organism into the hatchery. Present control measures consist of holding the diseased stock in strict quarantine at the hatchery and prohibiting their release or removal. Depending upon the results of sampling and surveillance, a recommendation will be put forward either to release the stock into the Puntledge River in May, 1984 as originally planned, or to destroy the fish and disinfect the ponds.

PKD, associated with chronic or severe losses of several species of salmonids in Europe and the United States, has caused particular alarm as so little is known about the pathogen, its pathology, mode of transmission, and control. Outbreaks appear to be favored by water temperatures over 15°C. Disease signs include anemia, popeye, abdominal distention, and dark skin but characteristically, a swollen, greyish, bulbously-ridged kidney. PKD frequently occurs concomitantly with other diseases that are often the ultimate cause of death. Infected fish are particularly susceptible to stressors such as handling, crowding, and low oxygen levels, so these should be avoided during outbreaks.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 24, 1984

MEMO NO. 96

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 756-7015

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

FOR FURTHER DETAILS CONTACT

D. Buxton, Chilliwack River Hatchery 858-7227

G. Hoskins, Pac. Biol. Stn. 756-7062

L. Schubert, Chilliwack River Hatchery 858-7227

Subject: Fish Health

Item: Treatment of Bacterial Gill Disease (BGD)

In British Columbia, and elsewhere in North America, BGD is a serious problem among salmonid fry. A number of chemotherapeutic agents have been used to combat this disease but none are entirely safe when administered to alevins or newly "buttoned-up" fry.

Recent tests have shown that chloramine T (para-toluene-sulphochloramide) is a safe treatment against BGD in chum salmon < 1 gram. At the Chilliwack Hatchery, 2 Cap troughs were each divided into two equal sections (upper-A and Lower-B) and loaded from a large concrete channel with affected chum. Each trough received the same size and number of fish (section A - 9,600 fry, mean wt 0.73 gm; section B - 18,200 alevins, mean wt 0.55 gm). Water flow was 159 L min/trough. Fish in both sections of one trough received a treatment consisting of 1 hr exposure to 8.5 mg/L of chloramine T metered into the inflow on each of 2 consecutive days. The second trough received no treatments.

Results

	Mortalities			
	Untreated Trough		Treated Trough	
Section	A	B	A	B
Day 1	55	ND	66	892
Day 2	109	2112	70	2080
Day 3	113	1000	108	1237
Day 4	102	662	62	420
Day 5	92	478	46	325
Day 6	131	528	27	175
Day 7	57	263	12	55

Although losses decreased in both troughs, probably because of improved environmental conditions, recovery occurred more rapidly in the treated group. Following these results, the entire stock of 1.278 million chum alevins and fry was treated (average size 0.64 gm). Chloramine T was administered by metering pump at 4.5 mg/L of inflow on day 1 and 8.5 mg/L on day 2.

Results	Mortalities
Day 1	11,000
Day 2	18,200
Day 3	12,600
Day 4	15,600
Day 5	6,290
Day 6	5,410
Day 7	4,780
Day 8	3,060
Day 9	1,597

The results indicate that losses from bacterial gill disease can be safely reduced in fry (less than 1 gram) by the use of chloramine T.

The chemical should be handled with care and only administered after a firm diagnosis has been obtained. The action of chloramine T appears to depend upon the formation of hypochlorous acid which releases the O radical as the active antimicrobial agent. Chloramine T should not be confused with toxic chloramines formed by the interaction of ammonia with chlorine.

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NI memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 3, 1984

MEMO NO. 97

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:

Gary Taccogna,
Community Advisor,
New Westminster Office,
524-7288

SUBJECT - Egg Incubation in Acidic Water Supplies

Item - The use of calcium carbonate chips

Due to the swampy nature of many Queen Charlotte Island watersheds, the streams are often very acidic (pH 4.0 - 6.5). While these streams support salmon and trout populations, egg incubation on such a water supply has consistently caused high mortality (30 - 60%) over the three-year history of a volunteer incubation project on Nadu Creek (pH 4.3).

In the fall of 1983, an experiment was initiated to reduce egg mortality. Two groups of 9,000 coho eggs each were placed on vexar trays in an upwelling gravel incubator. One group served as a control, while the other included a layer of about one kilogram of marble chips ($CaCO_3$) placed onto the egg tray prior to planting fertilized eggs. All other conditions were the same for both groups.

The pH of the water upwelling through the experimental tray increased by approximately 0.5 units over the level in the untreated tray. The project proceeded until the eggs reached the eyed stage, at which time freezing problems forced an end to the experiment. Comparative survival rates to the eyed stage were 60% in the control group and 95% in the treated group. Most of the mortality in the control group occurred within one week of planting the fertilized eggs.

Calcium carbonate chips are readily available, inexpensive, and easily added to an egg tray. No cleaning or sterilizing is required prior to their use. While this application shows promise in acidic water supplies, a study should be carried through to a post-release assessment of fry survival to evaluate its effectiveness fully.

Cost and Supplier: Calcium carbonate chips are sold as "marble chips" by Fisher Scientific Co. Ltd., 196 West 3rd Avenue, Vancouver 872-7641. Cost is $40/10 kg.

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Nanaimo, B.C. 758-5202

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Vancouver, B.C. 666-3855

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West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:

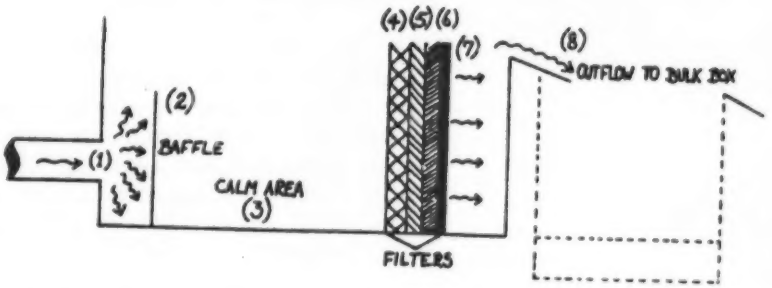
Ross Squire,
Ray Volk,
Ed Britton,
Robertson Crk. Hatchery
724-6521

SUBJECT - Water Filtration

Item - Simple filter box

A simple filter box has been successfully used to filter water for a bulk box incubator. Previously, suspended material has settled on eggs, alevins and screens, causing flow blockages and suffocation.

The filter box, measuring approximately 80 cm long, 60 cm wide and 50 cm deep, is constructed of plywood.



SIDE VIEW OF SIMPLE FILTER BOX (not to scale)

The gravity water enters through a 6.25 cm (2 1/2") PVC pipe (1) and is deflected by a simple, flat aluminum baffle (2) to reduce velocity and allow settling of heavy suspended solids in calm area (3). Most organic material is trapped by first filter media (4). This is a permanent-type furnace filter, available at hardware stores. Smaller suspended debris is caught by bonded polyester material (5); very fine silt is filtered by 1.25 cm (1/2") low-density foam rubber (6). The latter two media are available from upholstery stores. An aluminum frame with flyscreen (7) supports the media. This is trimmed with foam rubber and is friction-fitted in position. Water flows out from a wide-lip outlet into bulk box (8).

With a media surface area of approximately 3000 cm^2, this simple filter box can clean up to 60 liters/min of moderately contaminated water. With higher flows or severely contaminated water, more surface area is recommended. Changes in turbidity will affect time between cleaning.

Cleaning of area (3) is accomplished with a siphon hose. A second clean series of filters is installed before the contaminated filters are removed and rinsed.

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memo

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DATE May 3, 1984

MEMO NO. 99

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish and Wildlife Branch
Victoria, B.C. 387-1961

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F.E.A. Wood - 80
West Van. Lab. - 7
Pac. Biol. Stn. - 38

For further details contact:

Margaret Birch,
Dept. of Fisheries & Oceans
11 - 1090 West Pender Str.,
Vancouver, B.C. V6E 2P1
666-2796

SUBJECT - Salmonid Biological Statistics

Item - The Biostandards computer data base

INTRODUCTION

Biostandards is a computer data base containing biological information on salmon, steelhead and cutthroat trout. The data base includes sex ratios, fecundity counts, proportions of jacks, age compositions, lengths, weights and the rates of survival from one life stage to another. This information was collected from a variety of literature sources — consultants' reports, personal memos, DFO records and files — and will be used to calculate standard survival and production rates for both wild and artificially produced stocks.

The information is stored in the form of records, each of which has a unique identification number. To examine a record fully, one must look at three screens in succession, displayed on one of the computer terminals located on the 5th, 9th or 11th floors of the building located at 1090 W. Pender St. In addition to the record number, a unique combination of reference fields distinguishes any record from all others.

Currently, there are about two thousand of these records stored on the data base. The system is maintained by the Regional Planning & Economics Branch through Block Brothers Data Consultants, and it is designed so that records may be added or deleted at any time.

REPORTS

These records may be examined individually, but more often users look at special collections of records known as "reports." The reports are compiled through programs written in a computer language called "Natural" and then stored in the computer's memory. Any of these programs can be recalled from the memory and the report can be printed within a day.

DOCUMENTATION

A catalogue of all available reports is on file with the Regional Planning & Economics Branch. If one of these existing reports does not list the information wanted — or even if it does not list the information in the way wanted — the program can be edited to specifications, or a new report can be designed from scratch.

In addition, the terminal operator's manual describes the procedure for signing onto a computer through one of the terminals either to examine individual records or to write a program.

We are now adding more records to the data base so that it will contain all available information contained in DFO files. We are particularly short of adult-return information for both wild and hatchery stocks. If you have information you believe suitable for the data base or want copies of any of the reports or documentation described above, please contact.

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INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE June 8, 1984

MEMO NO. 100

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 756-7015

A. Wood, Fisheries and Oceans
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-1961

DISTRIBUTION

T. Bird - 5
D. Deans - 40
A. Lill - 3
D. Narver - 17
K. Sandercock - 35
F.E.A. Wood - 84
West Van. Lab. - 7
Pac. Biol. Stat. - 38

FOR FURTHER DETAILS CONTACT

Trevor Morris
Community Advisor,
Victoria Office,
388-3252

SUBJECT - Holding Adult Coho Brood Stock
Item - Use of PVC tubes for holding

Using lengths of PVC pipe in Capilano troughs, the Sooke Conservation Society, a public involvement group, successfully held adult coho brood stock to maturity at their project on Rocky Creek, a tributary of De Mamiel Creek.

Benefits are: reduced brood stock handling, which in turn reduces damage and subsequent disease, stress and egg loss; better accessibility for checking individual fish; no need for anaesthetic because the fish remain calm; efficient use of existing rearing facilities; compactness.

Tube specifications: PVC pipe 15 cm (6") diameter for females, 20 cm (8") diameter for males, about 75 cm (30") long for coho. (The length of the tube should be just slighty longer than the fish.) The inside of the tube should be smooth so that there is no damage to the fish. Both black and white tubes have been used with success.

Tube arrangements: Bundle the tubes together in groups of 10 (three on top, four in the middle, three on the bottom) and tie them together with a sash cord around the outside. Letter each bundle and number each tube for easy identification of individual fish. As many as five bundles can be put into a Capilano rearing trough.

Prevent fish from escaping by securing a section of 1.25 cm (1/2") or 1.56 cm (5/8") plywood at the upstream end of each bundle. Cut the plywood to fit the cross-sectional shape of the trough and drill the plywood with a series of 1.25 cm (1/2") to 1.88 cm (3/4") holes spaced 5 cm (2") apart and in rows 5 cm (2") apart. Secure the plywood to the tubes with a sash cord and lower the first bundle into the trough (rocks or cement blocks may be needed to weight the bundles down). Load the fish into the first bundle and place the next bundle flush against the first; load the fish and place the next bundle and so on until all the bundles are loaded. The last bundle will need a second piece of plywood or a screen placed at the downstream end to prevent fish from escaping.

Water specifications: Although variable, the water flow should not exceed the maximum of 200 litres per minute.

Adult holding: Coho adults were held for three months with this system (from September until they were spawned in December). It is recommended that the fish show some slight coloration before they are held. The Sooke Conservation Society found that "silver bright" fish did not seem to mature and some females showed reabsorption of eggs.

To check for ripeness, lift the downstream end of the tubes out of the water at a 45° angle, pull the fish out by the tail, check the fish and record the information by bundle letter and tube number. If there are any signs of fungus, treat the affected area at this time and load the fish back into the tube. Because the fish remain calm during this procedure, no anaesthetic is required.

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